



EDITORIAL
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MAGAZINE

The Big Screen

17 Ways to Widen
Your Perspective



3-D Graphics

20 New
Boards
For Hot
Graphics Acceleration



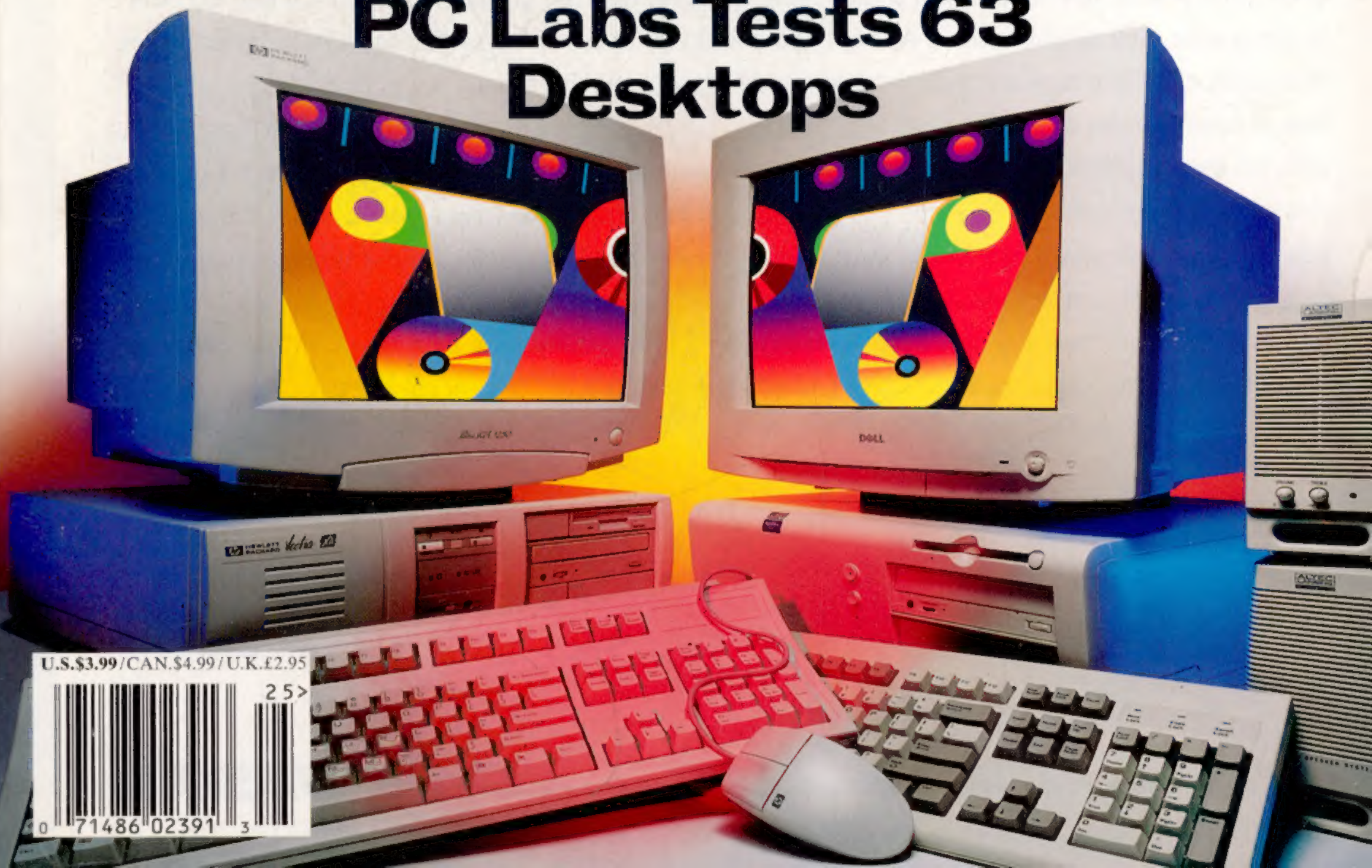
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Remember the Web?



I'm getting almost nostalgic for the good ol' days of the World Wide Web. You remember: a time when anyone could post a page in simple HTML, and any browser could read it. It was a great idea that worked well.

Nowadays, there are only two browsers that seem to matter: Netscape Navigator, which is part of the Netscape

Communicator suite, and Microsoft Internet Explorer. Each is moving from Version 3.0 to 4.0, and each promises significant improvements. That's good news, but there's trouble brewing: HTML isn't HTML anymore.

Communicator 4.0, which is in late beta as I write this, moves the overall product into the groupware arena. It has far better mail and news features, including such things as secure e-mail attachments and Colabla discussions.

Much of the program, including the Navigator 4.0 browser, focuses on new HTML features. These include Netscape's version of dynamic HTML, which lets you create a page that can be interactive within the browser. Such pages would be bigger than standard pages but wouldn't require going out to the server for new pages as much. Also, Navigator 4.0 supports more advanced style sheets and fonts. It's a big step toward making HTML pages feel more customized and responsive.

Much attention has been paid to Netcaster—Netscape's new push technology, formerly called Constellation. Netcaster lets a site creator take a Web site with HTML, Java, and JavaScript and turn it into a channel that can be viewed within the browser as a full-screen window or on your desktop. You can set how often you want each site to be updated and how much of the site you want to take with you. It's very neat.

Not to be outdone, Microsoft is pushing forward with Internet Explorer 4.0. Equally ambitious, IE also tries to redefine HTML, with its version of cascading style sheets, font controls, and dynamic HTML—an implementation that's frankly more sophisticated than Netscape's. Again, all of these could allow for great advances in page design. Microsoft has also improved the built-in mail, with its renamed Outlook Express client.

The most striking thing about IE 4.0 is its Active Desktop, which allows the browser and push technology to be integrated with the Windows Desktop. One nice thing is that you can view your local hard disk and server the same way you view the Internet, letting you use HTML features to make your directories more interesting and informative than a series of icons or a directory list.

You can also receive push content using a new format that Microsoft calls CDF. Most companies that talk about push endorse this standard, except for Netscape and Marimba. Although it's not quite finished, the concept of an integrated desktop/browser sounds good.

IE offers a lot of features, but it's earlier in the cycle than Communicator 4.0, so I expect some of the momentum will swing toward Netscape until Microsoft makes IE part of the standard Windows OS expected in early 1998. As I write this, IE 4.0 is not even in real beta.

It's important to note that Microsoft implemented all of these browser features differently than Netscape, and that worries me.

Don't get me wrong: Both browsers have great new features, and I'm sure we'll all move to one or the other. But look for both companies to submit their "standards" to the World Wide Web consortium. In truth, each wants differences, so it has something it controls.

What will content developers do? The options are limiting. They can tailor their sites to one browser, detect the browser in use to deliver the best pages possible, or go with the old HTML standard, forgoing new features.

What will users do? Most will upgrade because of the new features. But many will run into sites that won't work optimally in their particular browsers, and some will keep two browsers around. In either case, the concept of a universal browser may be lost.

As Joni Mitchell once said, "You don't know what you've got till it's gone."

Michael J. Miller
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COVER STORY



MMX Means Business

BY ROBERT S. ANTHONY

Play that funky music! And maybe some games and video apps. But there's little or no MMX-enabled business software. So are these business systems? Until application titles turn up, the MMX premium buys business users smoother video and better audio. We found some of these systems clearly intended for business use—with network cards and support for DMI—but many are targeted for the home100

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What's New Online

Hardware Heaven

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Summer 1997

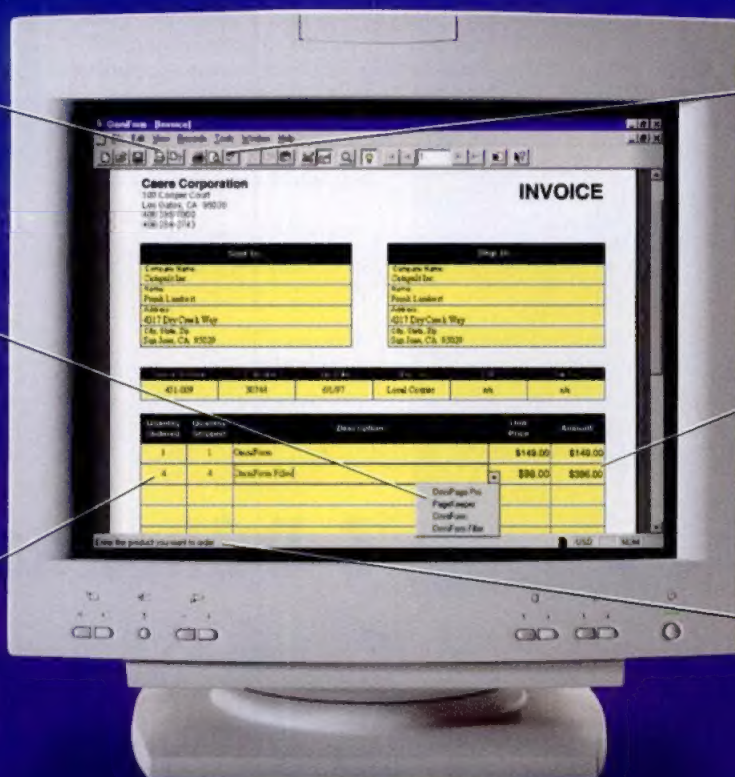
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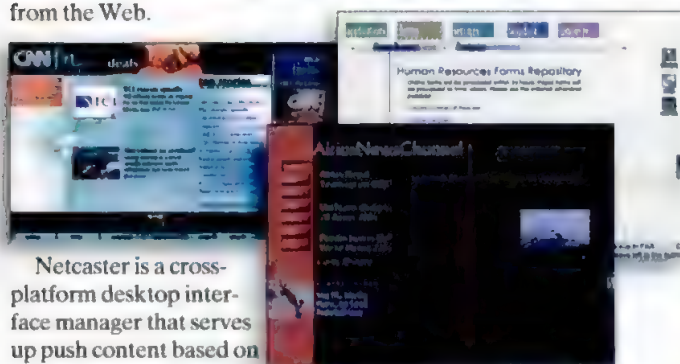
Pipeline

And Now, the Webtop

Netscape has announced its most ambitious offering in the push content arena: Netcaster. Formerly code-named Constellation, Netcaster lets you configure your desktop as a "Webtop," which can receive rolling tickers of news and information that the program automatically culls and updates from the Web.

The program enables off-line browsing and includes a Channel Finder: a list of high-profile content channels you can receive. A future version will incorporate an intelligent-agent technology—dubbed Compass—for sifting through information.

During the second quarter of this year, Netscape's Communi-



Netcaster is a cross-platform desktop interface manager that serves up push content based on HTML as well as Java.

You can centrally administer it to broadcast corporate information on an intranet. Or instead, the individual user can configure channels to receive personalized push content, such as news, from Web sites. Like Marimba, Netcaster uses a channel metaphor for organizing content from various providers.

cator will ship with Netcaster built in. According to Netscape vice president Marc Andreessen, "Our goal with Netcaster is to make information itself the desktop interface."

Microsoft's upcoming Memphis, the next version of Windows, will include push content options similar to Netcaster's.

Online: PCs, Monitors, and More



Join us online for extended coverage of this issue's evaluations of business desktop PCs,

large monitors, and graphics cards. The interactive viewers for our feature stories will help you zero in on the equipment that best fits your needs, and our interactive benchmark test viewers will tell you how your choices do in our rigorous testing.

THE INTERNETUSER FILES: Among the 500 Internet products in 60 categories that we've reviewed in InternetUser, a handful stand out as essential downloads. Take a look at our picks by surfing straight to www.pcmag.com/iu/essential.htm, and grab a few for yourself.

ALSO ON THE WEB: Check in every day at our NewsWatch page to catch up on the latest Trends and news analysis, along with late-breaking new-product announcements and our daily summary of computer coverage appearing in the mainstream press, NewsScan.

Surfing for Stocks

While many shoppers have shied from the idea of Web purchases, transactions through Web-based brokerages have soared, and a crop of free and nearly-free financial research sites has emerged.

Thomson's site Market Edge (www.marketedge.com) offers company and mutual-fund reports and historical security-pricing data for \$7.95 a month—far less than what a traditional brokerage would charge. The Daily Rocket (www.dailyrocket.com) offers similar services for free, pushing financial news headlines and quotes to your desktop. And at Papyrus's site (www.papyrus.com), you can download a free



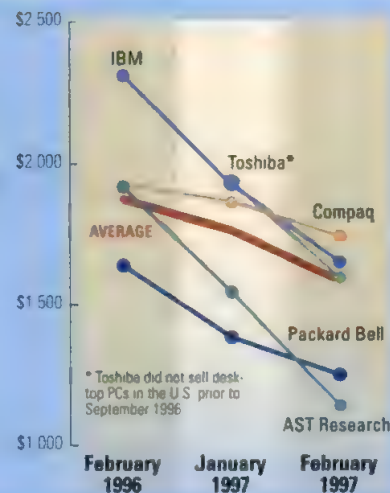
version of Internet Trader, which has much of the charting sophistication of technical-analysis products.

According to The Daily Rocket's CEO, Noah Pratt, "The data in a professional investor's expensive Bloomberg terminal can and should become free on the Web."

PC Prices Plummet in Superstores

PCs for as little as \$800 have helped spark a new wave of sales in the U.S. retail PC market. But although unit sales are on the upswing, revenue growth is falling because of a decline in average prices in PC superstores and in sales of higher-priced models.

Source: Computer intelligence average prices for superstore PC sales



Goggleless 3-D

Shed the specs. New 3-D technology from Floating Images promises you computer games with dramatic three-dimensional depth—but without special goggles or glasses.

Real-Depth halves the display horizontally and places a mirror box in front of the screen; you view the top half through an opening in the box, but you can't see the bottom half. Mirrors reflect the bottom half of the image upward and out of the opening. You see the image's top half as the foreground and its bottom half as the background.

Even though the method provides only two image planes, the effect can be striking. By moving your head from side to side, you can look behind foreground objects to focus on the background plane, enhancing the 3-D effect.

Pipeline

Kasparov's Chess Mess

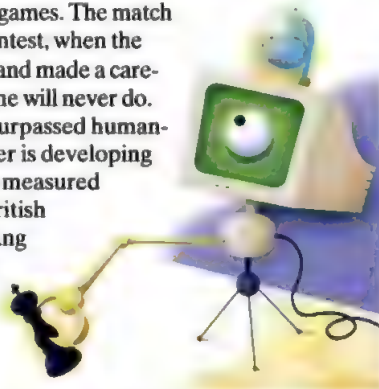


Next stop: the HAL 9000. In a seminal chess match last month, IBM's supercomputer Deep Blue defeated world champion Garry Kasparov and marked a new era in the development of artificial intelligence. Playing with a humanlike wherewithal at times, the 1.4-ton machine put fear into the famously unflappable Kasparov and won the match with a score of 3½ to 2½.

Deep Blue is a 32-node IBM RS/6000 SP computer built around 30 Power Two Super Chip processors. Each node houses eight chess-specific processors, allowing the system to examine 200 million positions each second. In 1 second, Kasparov—perhaps the greatest chess player who's ever lived—can evaluate no more than three positions. The Russian also trails in the area of sangfroid. In a machine, after all, nerves of steel are a given.

Though Kasparov won the first game using his sole advantage—gut instinct—Deep Blue managed two wins and three draws over the following five games. The match was in doubt until the final contest, when the champion lost concentration and made a careless error, something a machine will never do.

Now that machines have surpassed humankind in chess, the next frontier is developing true artificial intelligence, as measured by the celebrated test that British computer scientist Alan Turing proposed over four decades ago. A computer is intelligent, Turing suggested, only if it can carry on an intelligent conversation.



Software in Your Hand

The race is on to attract developers to Microsoft Windows CE, an operating system for hand-held computing. In the early going, it appears that Windows CE will generate the industry partnerships that could

developers for Windows CE, with products running the gamut from wireless-communications hardware to forms-design software and Microsoft's own adaptation of Visual C++.

While Windows CE systems have pull with Windows 95 users, there's potentially plenty of room for diversity. "Microsoft's entry has validated the market," says Diana Hwang of research firm IDC. "But it remains to be seen whether Windows CE will be the sole driver of this market," she says, citing the success of U.S. Robotics' Pilot.

Apple and Psion also offer mature, powerful systems that are unlikely to disappear before the Windows CE onslaught.

Input data into your Windows CE H/PC by writing directly *On the screen*



make it the first truly broad-based hand-held-computing platform. It may also have broad coattails, with Apple Computer and Psion reporting rising interest in hand-held platforms.

Microsoft cites more than 40

THIS ISSUE'S CONTRIBUTORS: Angela Hickman, Jonathan Matzkin, Cade Metz, Alfred Poor, Sebastian Rupley, and Don Willmott.

Reflect like a Butterfly

New flat-panel technology on the horizon is following nature's lead. Boston-based start-up Iridigm Display Corp. has developed a way to light displays better and more efficiently than reflective LCDs, with what it calls "digital paper," a technology that reflects natural light.

According to Iridigm, you'll be able to view full-color displays anywhere, be it in low light or bright sunshine. The displays are expected to appear first on cellular phones and PDAs.

The key is Iridigm's IMod



(Interferometric Modulator), a technology that applies current to the digital paper's microscopic structures—a lot like the iridescent scales on butterfly wings—which allow the pixels to change color.

Down the road, Iridigm plans to integrate IMod technology into notebook computers and car dashboard displays.

MSN's New Cyber-Lineup

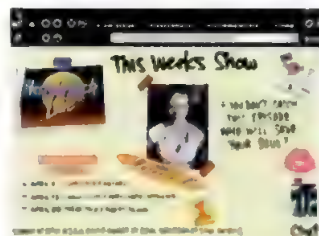
Sweeps came early in cyberspace. The new and improved Microsoft Network dropped several programs from its original lineup to make way for 14 new ones, which aim at a broader range of visitors and make better use of the medium.

The new programming targets families, women, and music enthusiasts and includes content from Disney's Daily Blast—a new site that features kids' games, interactive stories, and news—and

Family.com, an online resource for parents. Also in the lineup: Personal Trainer and @Water-cooler, which offer health and fitness programs and address workplace issues, such as networking resources. In addition, VH-1 and MSN are teaming up for Hard Rock Live, a Web companion to the weekly concert broadcast. And a new

show called Mama Planet will offer a place for folks to learn about the environment.

MSN has 2.5 million members worldwide.



Top Retail Business Software

- 1 **Microsoft Windows 95 Upgrade** Microsoft
- 2 **Viruscan** McAfee
- 3 **Norton AntiVirus** Symantec
- 4 **First Aid Deluxe** CyberMedia
- 5 **First Aid** CyberMedia
- 6 **Microsoft Office Professional 97 Upgrade** Microsoft
- 7 **Norton Utilities** Symantec
- 8 **Microsoft Plus** Microsoft
- 9 **Netscape Navigator Personal Edition** Netscape Communications
- 10 **Viruscan Deluxe** McAfee

Source: PC Data Data for March 1997

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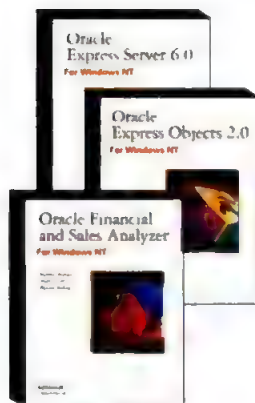
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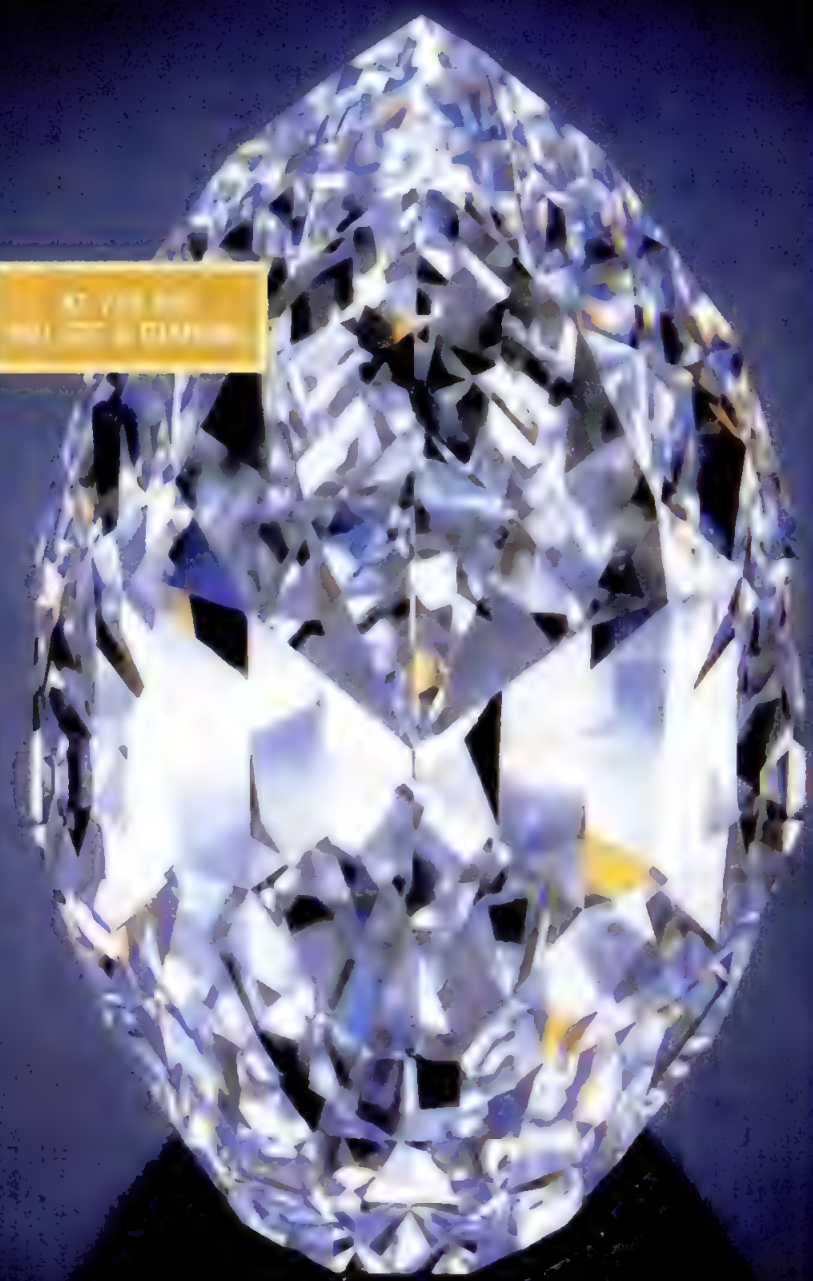
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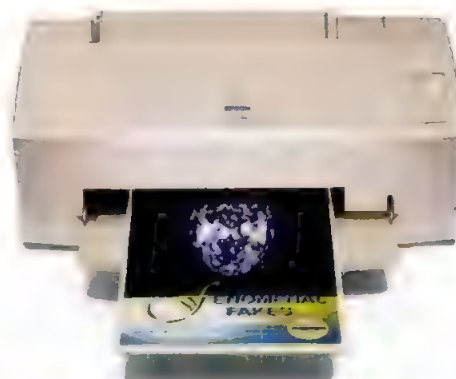
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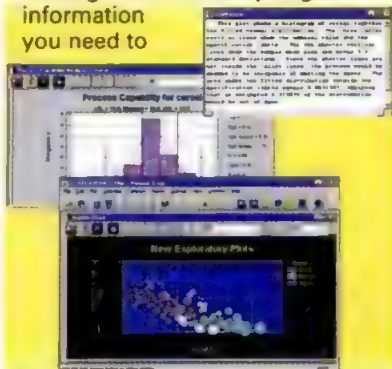
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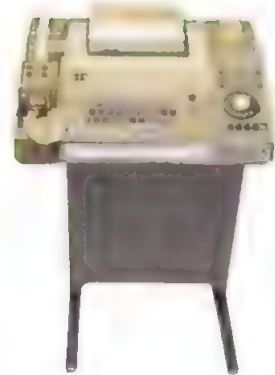
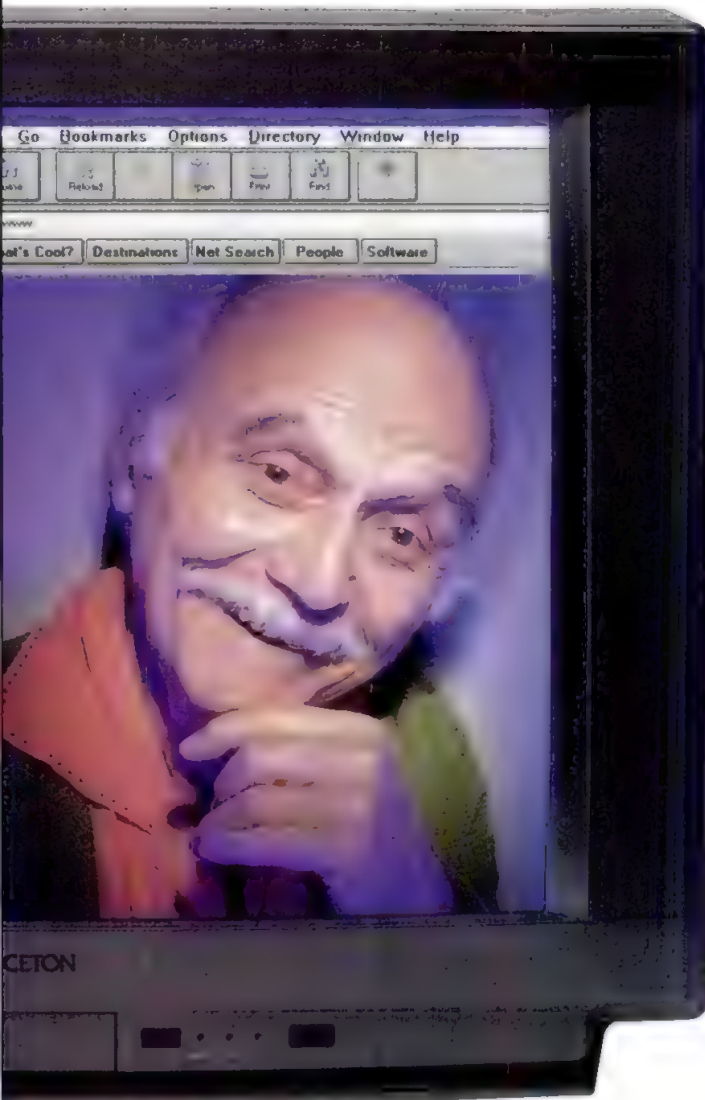
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the monitor

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Letters

TOO MUCH OF A FILTER?

I disagree with your decision to give the Editors' Choice award to Cybersitter ("Internet Filtering Utilities," April 8, 1997). It is of great concern to me that this program has received such a high honor from such a prestigious magazine. Solid Oak Software, in my opinion, has been biased in its choice as to what is detrimental to the children of America, and has been unfriendly to anyone voicing a complaint. This doesn't seem like appropriate conduct for an organization that we're trusting to protect children.

SCOTT ZARCENSKY
via the Internet

I was very displeased to see that you gave Cybersitter your Editors' Choice award, because the program was created by opponents of Internet free speech who use a "secret list of obscene Web pages" to carry out personal vendettas against people who criticize them. I don't think that banning such sites as the National Organization of Women and the International Gay and Lesbian Human Rights Commission is the proper way to go about keeping obscene material from our children.

CHRIS DUFFY
via the Internet

Our focus in the review of Internet filtering utilities was on a product's ability to block sites and on its ease of use. We did not evaluate each product's personality or politics, although each product we reviewed imposes a certain set of guidelines about sites that are blocked. In general, these products tend to err on the side of caution, which is in keeping with the reason that parents look to such a product in the first place.—Ed.

LONE BACKUPS IGNORED

You did a nice job on the Utilities issue (April 8, 1997), with one major exception. After all the years of preaching about the importance of backups and safeguarding your data, how could you omit a review of backup products for nonnetworked, standalone PCs? Considering the continuing coverage of all the new backup media and storage devices and multigigabyte storage standards, a review of the Windows 95 backup (and other) software is essential.

ANDY WOLF
via the Internet

Having read hundreds of articles and editorials on the importance of backing up one's computer, I was amazed that nothing was said about nonnetwork backup programs. I reread the introduction to the Utilities articles just to make sure that I hadn't missed something.



I disagree with your decision to give Editors' Choice to Cybersitter.

This is the second year in a row you have played this game.

WINTHROP BISSELL
via the Internet

It's something we should consider for next year. The desktop backup market has changed in the face of more powerful operating systems—Windows 95 and Windows NT—which have backup utilities built-in. We did review a newer approach: packages and services that let you back up files over the Web ("Web Backup Tools," page 263). We also did some snapshots of backup packages for Windows NT and OS/2 in that issue. Naturally, backing up over the Web is a better choice for users who want to back up only data files rather than whole systems and for users who don't want to bother with a full backup.—Ed.

OVERSHADOWED

I picked up your April 8, 1997, issue ("The 1997 Utility Guide"). Inside, you had 145 pages of Windows 95 utility reviews and exactly 2 1/2 columns devoted to Windows 3.x.

STEVE HEARD
Halifax, Canada

GOING OFF-LINE

I strongly disagree with the conclusion of the article "Internet Off-Line Search Utilities" (April 8, 1997). You selected Internet FastFind as the Editors' Choice because of its bundle of "Web-related conveniences," freely admitting that none of the utilities can compare on a feature-to-feature basis with those of their competitors. Bundling a nice package of utili-

ties should have no bearing in an evaluation of a specific application product category.

DAVE WARAR
Libertyville, Illinois

How could you award the best in class to a program in which the user can't search returned results off-line? I own three of the six programs reviewed, and I discarded two others during prepurchase testing. For the most part I agree with the reviews; however, Internet FastFind suffers several shortcomings.

DON JOHNSON
via the Internet

THE CHICKEN AND THE EGG

Jake Kirchner airs an excellent question about smart cards ("Of Chickens, Eggs, and Smart Cards," April 8, 1997)—namely, what makes them better than cash? His answer was bonuses like frequent-flier miles, which is fine except for one thing. Who pays for all of this? Nothing comes for free; for example, the frequent-flier miles I used to get on my credit card came with 6 percent higher interest than on competing cards.

CALVIN CRUMRINE
via the Internet

I believe that smart cards would be very useful if they were coded with PIN numbers so that thieves wouldn't be able to use them, and victims of robberies wouldn't have to worry. I would much rather carry around a thin card than a fat wad of cash.

DAVE POLLACK
via the Internet

TRACING THE NET

I was really impressed with John C. Dvorak's column in the April 8, 1997, issue ("Breaking Up the Internet Logjam"). For quite some time I have been searching for something that would let me visually observe the legs of a trip to a Web site; that is, what path a packet takes between PC and server. The Windows 95 feature TRACERT is exactly what I have been looking for.

IRVIN J. HALTER
Virginia Beach, Virginia

I note with amusement that Dvorak considers Trace Route a "little-known feature of Windows 95." Trace Route is a TCP/IP utility that can be found in most if not all Unix implementations, OS/2 Warp 4, and even Windows NT.

JEFF SHULTZ
via the Internet

I think that Dvorak has fallen under the spell of Microsoft hype and, like Microsoft, has forgotten all about Windows for Workgroups

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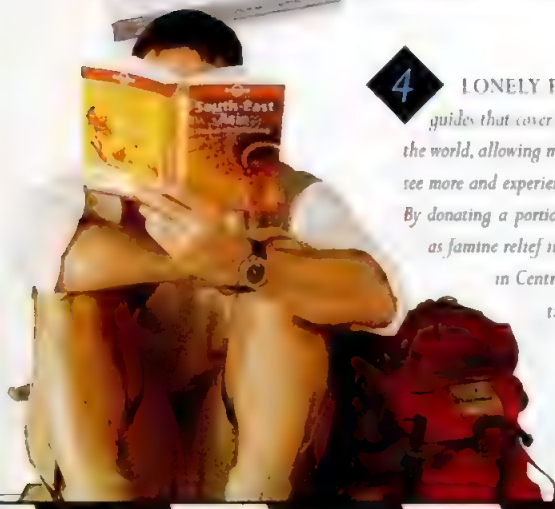


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Which is no minor feat. (It is, after all, not such a small world.) It involves coordinating a staff of 50 writers and 90 support people in their Oakland, Melbourne, and Paris offices. At the heart of their effort is a paper trail of substantial proportions. And at the soul of it is the NEC® SuperScript 1260 laser printer.



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CIRCLE 217 ON READER SERVICE CARD

Letters

3.11 (WfW). TRACERT was available with WfW when Microsoft TCP/IP was loaded.

WILL ENGLERT
via the Internet

INTERNET, PART DEUX

There have been several articles lately describing how universities around the country are trying to build a new Internet for their exclusive use ("Breaking Up the Internet Logjam"). This, of course, would be funded by tax dollars. In Iowa, funds are being sought on both the state and federal levels. I agree with the people involved who are saying that low bandwidth, lost data packets, and slowness on the Web are problems every Internet user faces. Instead of spending tens of millions of dollars on a private Internet, let's take those same tax dollars and apply them to solutions for everyone.

AUSTIN MYERS
via the Internet

PARTITION INSURANCE

Thanks to Jim Seymour for his timely tips on partitioning and backing up hard disks ("Free Hard Disk Space! Fast Backups!", April 8, 1997). I'm not sure he meant to imply, however, that you should skip backing up your application partition altogether. For mature, complex Windows installations, it's almost impossible to restore a setup from master disks.

ROGER F. MEYER
St. Louis, Missouri

Seymour's column informed me how much wasted space DOS accumulates, which gives me a great reason to move to Windows NT or OS/2. On the other hand, I found his second benefit—division of data from applications

HOW TO CONTACT US

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CORRECTIONS AND AMPLIFICATIONS

In our April 22, 1997, article "The PC Palette: Image Editing," the street price for each of the Traditional, Geometric, and Artistic packages in Auto F/X's Photo/Graphic Edges 3.0 series—described in the sidebar "Getting Plugged In" (page 166)—should be \$180. In the same article, the list price of MGI PhotoSuite in the sidebar "Entry-Level Image-Editing Tools" (page 175) should be \$49.

Our April 22, 1997, article "The PC Palette" did not include full author credits. Daniel Grotta, Sally Wiener Grotta, and Luisa Simone are contributing editors of *PC Magazine*. Linda and Erick Von Schweber are founders of InfoManiacs (www.infomaniacs.com), a think tank in cyberspace with an outpost in Sedona, Arizona. Danile Levine is a freelance writer. Lori Grunin was the acting project leader, and John Morris was the associate editor in charge of this story.

In our April 8, 1997, cover story, "The 1997 Utility Guide," the table "It's In There" on page 103 incorrectly stated that NTBACKUP will back up to tape or floppy disk. It will back up only to a tape device on the HCL—in other words, none of the parallel-port tape drives. If you want to use floppy disks, any of the 32-bit ZIP programs mentioned in the same issue will do the job, with the advantage that the output .ZIP file can be read by any application that supports .ZIP, while NTBACKUP can be read only by NTBACKUP.

In the Editors' Choice sidebar of the April 8, 1997, article "File-View Utilities" (page 155), we stated that none of the vendors supported Microsoft Office 97 at that time. Although none of the products supported these file types out of the box, FTP Software (www.ftp.com) posted a patch on its Web site in January that provides Office 97 support for its file viewers, KEYview 5.1 and KEYview Pro 5.1.

for the purpose of backing up only the data—short-sighted.

LEE SOMERMAN
via the Internet

KEEP ON CODING

In "Getting into a Higher Gear" (March 25, 1997), Bill Machrone says that he is not quite sure why developers choose C++. I use C++ daily because its programs don't crumble when being maintained. Since C++ code is more isolated into each class definition, it is harder to make changes that will break the code outside that class. I have been working on one program in C++ for four years now. It continues to become more stable. On the other hand, a much smaller C program has become increasingly unstable over the same period of time.

BOB MCCLELLAN
via the Internet

I was dismayed to see Machrone's comments about looking forward to the day we won't have to hand-code Web pages. Unless automated HTML programming tools do a much better job of optimizing code than the current crop of programming tools for other languages, I don't share his hopes. Hand-coded code is synonymous with tight, efficient, compact programs, and all of these attributes are essential to acceptable Web-page performance.

SEAN MCGINTY
via the Internet

BAFFLED BY BAD BOOKMARKING

You dropped the ball on the 16-bit browser comparison ("16-Bit Browser Battles") in the April 8, 1997, issue. You fail to mention Inter-

net Explorer's biggest shortcoming: its inability to organize bookmarks into folders. I suspect that this handicap kills it as a serious competitor to Netscape for many users. It's unbelievable that this feature, which Microsoft saw fit to incorporate into the Macintosh version of Internet Explorer (IE), was left off of the new version of IE for Windows 3.1.

ERIC M. WINSLOW
via the Internet

NOT SO INCREDIBLE

John C. Dvorak talks about Tandy's Incredible Universe megastore in his March 25, 1997, Inside Track column—and the reason for its failure. I agree with him that location was a problem, but the company was also trying to integrate the Disney experience into retail buying. That experience does not translate well into retail, however, because there is a difference between being on vacation and making a major purchase. When I plan to spend \$2,000 for a computer I want to be informed, not entertained.

JEFF HAMMACK
Indianapolis, Indiana

Although Tandy did put its Incredible Universe stores into some ridiculous places, location wasn't the sole reason for their demise. I once entered an IU store, desiring to talk to the computer department manager. I approached a purple-clad employee who was busy playing DOOM on a display computer and asked if he knew where the manager could be found. "Uh-uh," the employee replied, never taking his eyes off the screen. Dvorak missed nothing but a headache.

WALT JAQUITH
Lafayette, Oregon



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Trends



Photo Op

Digital developments for weekend photographers.

Picture this: a digital camera networked to a printer; a fax machine dedicated to receiving and transmitting photos; a password-protected Web site that stores and delivers photos; a \$300 digital camera with a stunning, million-pixel resolution.

Several trends are radically changing how weekend photographers take pictures, process them, and share them, but the future of consumer photography isn't one-size-fits-all. Not everyone will need a digital camera or even a PC to take advantage of digitized photos.

In fact, the cornerstone of a new Kodak strategy is "digitization"—the transferring of photos on traditional silver-halide film into digital format so you can manipulate, send, store, and retrieve them via the Web without having used a digital camera. This approach keeps photo retailers, who process some 75 billion consumer photos a year, in the loop. "Digital is supplementary and complementary to silver halide," says Kodak CEO George M. C. Fisher.

Still, the proliferation and the plummeting prices of digital cameras are key drivers of the market. For instance,

Kodak's low-end model—the DC20—sells for \$199. (This issue's First Looks reviews four of the cameras shown below.) Look for even more innovative digital cameras to debut this summer.

Meanwhile, software and hardware developers are adopting common standards. Camera makers are using tiny standardized flash-memory cards that store digital images, and the new file format FlashPix is the emerging standard for digital photos. Since FlashPix stores an image in multiple resolutions, applications can choose the appropriate resolution for each task. For instance, FlashPix will send a high-res image to a printer, a low-res image to the Web (for rapid transmission), and the minimum resolution necessary for editing on-screen. Live Picture's LivePix and Microsoft's PictureIt are among the growing number of applications that support the format.

IMAGE MAKERS: New Web photo services include PictraNet Publish & Share (shown here) and Kodak's Picture Network. Among the latest digital cameras to hit the market are new models from Canon, Casio, Epson, Kodak, and Nikon.



Hardware developers are also swiftly coming up with improvements. Rather than using costly charge-coupled devices (CCD)—the photosensitive semiconductor chips that digitize images—companies such as SoundVision are turning to the cheaper complementary metal-oxide semiconductor (CMOS) photodiodes, which consume one-tenth as much power as CCDs. Toshiba says it has licked the inherent CMOS "noise" problems and is using the method for imaging circuitry. And LSI Logic recently announced a chip, the DCAM-101, that it claims will permit smaller digital cameras with far greater picture quality—at price reductions of 25 percent, according to research firm Dataquest.

WEB PHOTO ALBUMS

It seems that no endeavor is complete these days without a Web strategy. Today, 70 percent of photo customers mail pictures to friends; in the future, says Kodak's Fisher, they'll e-mail photos. In May Kodak launched The Picture Network, which it expects to offer at 30,000 retail photo counters in the U.S. To post your pictures online, you check "Kodak Picture Network" on the photofinishing bag when you get your film developed. When you pick up your prints, you'll receive a claim number for accessing them on the Web, where you'll be able to order reprints and e-mail photos to friends.

The Web is also a launchpad for smaller entrepreneurs. A service from Picture Vision, PhotoNet, is available through 7,700 stores in the U.S. and 800 in Japan, and it will soon be available in Europe. And start-up Pictra recently launched PictraNet Publish & Share, a subscription-based Web site where you can create digital photo albums and share them via a personalized Web address.

But a barrier to wider acceptance of digital photography, says Fisher, is the complexity of using the cameras. "Ease of use," he says, "will be the primary driver of acceptance much more than the technology itself." So when will the real explosion in digital photography happen? Says Fisher, "When the \$300, million-pixel digital camera arrives." When will that be? Fisher doesn't say, but he vows Kodak will be first.—Carol Levin

PC Labs Builds a 300-MHz Machine

Tests show astounding speed gains.

According to industry sources, only ten working 300-MHz Pentium II processors existed until recently; Intel's \$1,981 processor is in short supply and may not arrive until midsummer. The first company to offer a motherboard certified to run the chip—counting Intel—is Tyan Computer. After receiving certification for its new Tahoe system boards, Tyan was afforded a pair of 300-MHz Pentium IIs, which the company carried to *PC Magazine's* PC Labs for benchmark testing. The results provide a glimpse at the high-speed future.

The Tahoe line comes in three flavors, each of which supports the three flavors of Intel's Pentium II. We tested the Tahoe 2 ATX, a dual-processor design built for the high-end

server and workstation markets. Like the Tahoe AT and Tahoe-A ATX, this \$399 board integrates Intel's Natoma FX chip set, an infrared port, and twin USB ports.

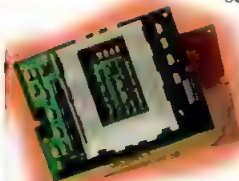
When we equipped the board with a 300-MHz processor, performance increased almost linearly under Microsoft Windows NT. Using a 10,000-rpm

Seagate Cheetah SCSI hard disk, a Matrox Millennium II graphics card, and 64MB of memory, our 300-MHz system surpassed the average speed of several 266-MHz Pentium II systems by 8 percent on the ZD Business Winstone 97 tests.

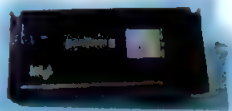
Each Tyan Tahoe board supports Intel's Pentium Pro as well. With the company's riser card, PC makers can give users an easy upgrade path from 180- and 200-MHz Pentium Pros to any version of the Pentium II.

Speeds after such an upgrade are astounding. In our tests, the 300-MHz Pentium II was 63 percent better than a 200-MHz Pentium Pro system on CPUmark₁₆ and was 38 percent better on CPUmark₃₂. Business Winstone numbers improved by 33 percent and High-End Winstone numbers by 52 percent.

What will the increased speed mean for high-end systems? The 300-MHz chip could give Intel breathing room relative to AMD's K6, a processor that comes close to matching the performance of the Pentium II under Windows 95.—Cade Metz



THE RISER CARD: This Tyan card upgrades PCs from Pentium Pro to Pentium II.



THE CARTRIDGE: The CPU/L2 cache cartridge is designed for easy processor upgrades.



16X CD-ROM Drives: The Truth

HAVE YOU SEEN ALL OF THE NEW DESKTOP systems that are shipping with 16X CD-ROM drives? We sure have. Twenty-one of the 63 MMX machines we received for reviewing in this issue's feature story "MMX Means Business" came with 16X drives. But unfortunately, if you expect a 16X drive to be 33 percent faster than a 12X model, you'll be sorely disappointed.

In our CD-ROM WinMark 97 benchmark tests—which profile drive performance while running six of today's most popular CD-ROMs—the 12X drives outperformed all but four 16X drives in our Sequential 16K Read test, which measures a drive's transfer rate in reading contiguous 16K blocks of data. In fact, the 16X machines performed more like 8X or 10X drives.

What gives? The answer is Constant Angular Velocity (CAV), used in part by many 16X models. Drives that employ this technique read data more quickly on a disk's outer area than on the inner section, because in a given time interval, more data passes under the laser read head in the outer area. To

illustrate this point, we placed the files for the Sequential 16K Read test on both the inside and outside areas of our test CD. As expected, when we performed the test using the outside section, most of the 16X drives read at close to the 16X rate, 2,400 Kbps.

In contrast, a Constant Linear Velocity (CLV) drive spins faster while reading the inside area than while scanning the outside, so it reads the entire disk at a constant rate. While our data suggest that many of the 16X drives used a combination of CAV and CLV, most of the 12X drives used only CLV. In our testing, the 12X CLV drives could spin the whole CD at 12X; the 16X

drives, using both CLV and CAV, could maintain 16X only on the outside and reached only 8X to 10X on the inside.

That should come close to between 12X and 13X performance on average, right? Well, not quite. Since CDs may not be filled to capacity, the outer section may not contain data at all (data is written from the inside toward the outside). And an absence of data on the outside looms large in performance results, since the radius of the outermost part of the track is about 2.5 times as great as that of the innermost. As a result,

the drive's performance at the outer part is less important than at the inner area.

To illustrate this, we considered the performance of a 16X CAV drive under two scenarios—one in which all the CDs in the world are filled with data to the outer edge, and one in which a Gaussian distribution (a bell curve) of CDs is centered around those filled halfway, at 325MB. The first scenario is the best possible case for CAV drives, while the second depicts a more realistic model.

Using these two distribution models as the weighting factors,

we calculated the adjusted X factors. In the ideal case, a 16X CAV drive acts more like a 12X CLV drive. In the more realistic scenario, the same drive is effectively a mere 9X CLV drive.

PC vendors are shipping "16X" drives not because they're faster but because they want buyers to think so. Consider the labels with some skepticism. While many drive makers just slap on "16X," more honest ones label theirs "16X Max" or specify "up to 16X" in the documentation. Whatever the case, our CD-ROM WinMark 97 tests prove that only a few of the 16X drives are faster than the 12X drives.—S. Jae Yang

Circular Thinking



We found that 12X drives read at 12X throughout the CD.



But 16X drives may read only at 8X where it counts the most.

Pushed, Pulled, Confused

The Push Technology Summit leaves vendors without answers.

When buyers, sellers, and creators of Web-based push technologies gathered recently in San Diego at the day-long Push Technology Summit, part of David Coursey's Internet Showcase, they expected to get a handle on the future of this fast-changing market. But as speaker after expert speaker made predictions, all that became clear is that no one really knows where push is going to end up.

The audience of 300—many of whom represented small push technology start-ups—listened with trepidation to Joe Belfiore, group program manager for Microsoft's Internet Explorer 4.0, and Mike McCue, Netscape's director of advanced client technology. The two took to the stage to demonstrate the similar—but not identical—push “channel” technologies that the companies are building into their browsers' next versions.

When an audience member asked whether Microsoft and Netscape are friends or foes to other companies plotting push strategies, both Belfiore and McCue tried to put a positive spin on their companies' plans, saying that any push technology company could work within the channel structure to create enhanced channels. As they pointed out, Microsoft is working closely with BackWeb, and Netscape has deals with Marimba.

Nevertheless, because Microsoft is promoting the new Channel Definition Format (CDF) while Netscape is not, some people in the crowd were obviously worried about competing standards.

Much of the rest of the time was taken up by speakers who worked their way through a litany of buzzwords—everything from “value chain,” “multicasting,” and “criticality” to the newly coined and as yet undefined “broad-

catching.” But these speakers never nailed down any solid conclusions about where push technology will go in the next six months.

The event's most interesting aspect was the instant polling throughout the day. After hearing Microsoft's and Netscape's approaches, the audience voted on who had the best strategy;

Microsoft earned 46 percent of the vote and Netscape 26 percent,

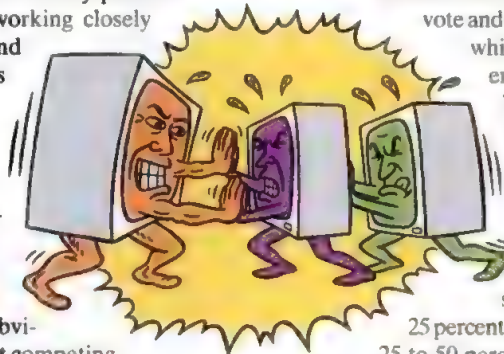
while 28 percent of voters chose “Other.”

When asked how much of their Internet information they thought they would receive via a push technology by 2002, 26 percent said it would be up to

25 percent, 31 percent said from

25 to 50 percent, 29 percent said

from 50 to 75 percent, and 14 percent said from 75 to 100 percent. So even though this admittedly self-interested crowd had little clue how it's going to happen, they did seem optimistic that push technology will soon take hold in a serious way.—Don Willmott



JAKE KIRCHNER

Today on Oprah: Eating Dog Food at Microsoft

I have to say up front that the title of this new business book put me off. *All I Really Need to Know in Business I Learned at Microsoft: Insider Strategies for Success* just didn't sing to me. As if we don't have enough Microsoft-related articles and books already, I thought. But once I flipped through my advance copy and found sections describing a number of people I know at the company, I found myself drawn in.

Despite the title, this book—slated for publication next month by Pocket Books—is a worthwhile read. But that's probably not for the reason you might think, since as a guide to management and career development (the book's stated purpose), it's a lightweight.

At slightly more than 100 pages, *All I Really Need to Know in Business* has only five chapters, each consisting of a dozen or so very short lessons supported by an anecdote that the author—Julie Bick, a former Microsoft product manager and marketing executive—derived from her years at the company.

As a quick and easy read, the book is a useful compendium of common-sense business, management, and supervisory practices, but the lessons the author learned are hardly specific to Microsoft. The fact that she learned them at that company makes the title an honest one, but it doesn't ensure that people at other large high-tech companies will learn anything they don't already know.

Unfortunately, the book is full of lessons no more insightful than “Make Your Boss Look Good,” “Know the Business Inside Out,” “Tailor Your Message to Your Customer,” “Praise Publicly, Chas-



tise Privately,” and “Keep Your One-Page Resume Up to Date.” And does anyone really need another lesson about e-mail etiquette or how to interview?

But if *All I Really Need to Know in Business* falls short as an addition to your shelf of management handbooks, I suspect it will succeed as a window into everyday life on the Microsoft campus. The introduction plays to our interest in the atmosphere at the company. “Say the word Microsoft and it conjures up all sorts of preconceived notions—from ruthless competitors to twenty-seven-year-old nerd millionaires working around the clock.” Later, we learn that “experiences that might take years to gain elsewhere come in bursts of just a few weeks at Microsoft. The pace is intense, the market changes constantly, the growth is phenomenal, and yes, you even get to see Bill Gates.”

You can expect that the author (now a consultant in Seattle) will spend most of her publicity tour describing what excites Bill Gates in meetings, explaining what “Microsofties” mean by “Eat your own dog food,” assuring everyone that bombastic executive vice-president Steve Ballmer really is a sweetheart, and sharing anecdotes, such as the one about the time Microsoft security guards identified trespassers by their suntans.

Deep down, all of us—at least those of us in the computer field—probably do want to know this stuff. And since it won't take you more than about an hour to get through the book, it's just as accessible as any *People* magazine feature. Or you can just skip the book and wait for the made-for-TV movie.

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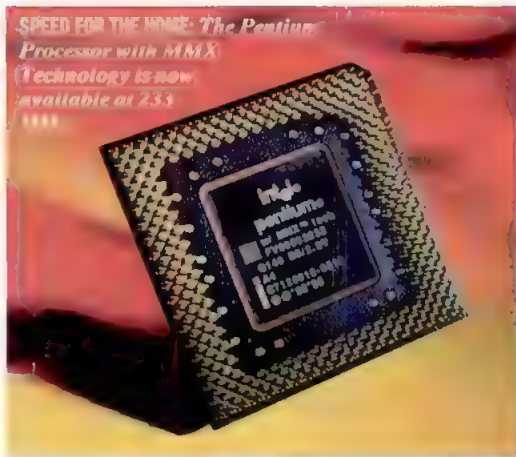
MMX Builds Momentum

In this issue's First Looks section, we juxtapose an early selection of AMD K6 PCs with a quartet of inaugural 233-MHz MMX Pentium machines. In addition to the latter four systems—from Dell Computer Corp., Gateway 2000, NEC Computer Systems Division, and Quantex Microsystems—several other major vendors will be selling Intel's latest consumer processor at, or close to, its early June announcement date.

Intergraph (800-692-8069, www.intergraph.com) is adding the 233-MHz MMX Pentium to the TD-25 line of corporate PCs (for more on corporate PCs, see "MMX Means Business" in this issue). Like its 200-MHz predecessor, the **233-MHz TD-25** is equipped with the Intel 430TX chip set, EDO DRAM (up to 64MB on two DIMM slots), and 512K of L2 cache. Intergraph's tool-free ATX design offers a standard 12X CD-ROM drive, two front-accessible 5.25-inch expansion bays, and one open internal 3.5-inch bay. The system is covered by Intergraph's three-year parts and one-year on-site labor warranty.

A wide range of graphics and disk subsystems can be added to the core design. EIDE, Ultra SCSI, and Ultra Wide SCSI hard disks are available, as are Matrox Millennium graphics boards and Intergraph's line of Intense 3D graphics engines. Other options include various 15-, 17-, and 21-inch monitors, a SCSI CD-Recordable drive, a multimedia keyboard, external speakers, a network adapter, and a modem.

It will likely sell for slightly more than the 200-MHz TD-25, which is priced at roughly \$3,000 with 17-inch monitor, 3.3GB EIDE hard disk, 32MB of RAM,



and 4MB graphics card.

As usual, ProGen Systems (800-848-1353, www.progen.com) is also one of the first vendors to market with new Intel silicon. After shipping a 200-MHz MMX Pentium at the new year and a Pentium II PC last month, the company has now introduced the

Atlas X 233. In addition to a clock speed of 233 MHz and MMX extensions, this multimedia system includes the Intel 430TX chip set, 512K of pipelined-burst L2 cache, and support for up to 512MB of EDO DRAM. ProGen's ProCare three-year limited warranty guarantees a year of on-site service.

The machine's ProGen GOLD 3D VGA graphics card uses the S3 ViRGE chip set and 4MB of EDO DRAM, while its Panasonic CD-ROM drive supports up to 24X speeds. A 3-D stereo wavetable audio subsystem is augmented by two 80W amplified stereo speakers, a subwoofer, and a stand-up microphone. A 17-inch Panasonic monitor and a 33.6-Kbps U.S. Robotics fax modem with voice mail and speakerphone capabilities come standard as well.

The average Atlas configura-

tion—which includes a 5.1GB EIDE Maxtor hard disk and 32MB of on-board EDO RAM—sells for about \$2,499. Several alternative configurations are available, including a SCSI model that's priced at \$2,749 for a 3.2GB SCSI disk, 64MB of memory, and a 12X SCSI CD-ROM drive.

Other major vendors were finalizing the specifics of their 233-MHz MMX Pentium plans. Micron Electronics (800-388-6334, www.mei.micron.com) will sell a high-end gaming system, and Acer America Corp. (800-558-2237, www.acer.com), AST Computer (800-876-4278, www.ast.com), Packard Bell (800-733-5858, www.packardbell.com), Sony (888-476-6972, www.sony.com/pc), and Toshiba (800-334-3445, www.computers.toshiba.com) will all likely offer standard home machines. Compaq Computer Corp. and Digital Equipment Corp. are probable players in the corporate market, but plans have not been set in either camp.—Cade Metz

SERVERS

The Ten-Way Pentium Pro Debuts

It just goes to show you: Eight was not enough. After recent eight-way Pentium Pro announcements from Corollary and NCR (see *Trends PCs*, "By Sixes and Eights," April 22, 1997), Unisys Corp. (888-278-2682, www.unisys.com) will soon introduce the industry's first ten-way Pentium Pro server. Designed for the gradual scaling of processing power, the **Aquanta XR/6** supports up to five P6 buses, each of which harbors two 200-MHz Pentium Pro processors.

The backbone of the XR/6 is the Scalable Coherent Memory (SCM) bus, a 64-bit Unisys technology that runs at 533 MBps. The machine's I/O bridge and ECC memory banks (which support up to 8GB of system RAM) attach directly to this central bus, which in turn interfaces with the standard P6 buses. To reduce traffic on the SCM, Unisys has augmented each



processor pair with 4MB of Level 3 cache.

This rack-mountable unit offers ten PCI slots, three EISA slots, and six drive bays for up to 52GB of internal storage. The disk subsystem is hot-pluggable, as is the standard power and cooling hardware. Though the machine is intended primarily for Windows NT networks (its server management package supports only the 32-bit Microsoft operating system), it can also be used with UnixWare and the proprietary Unisys SVR4 MP Unix.

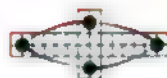
A basic XR/6 configuration that has two 200-MHz Pentium Pro chips, 512K of integrated

L2 cache on each processor, and 1GB of memory sells for \$62,734. A typical purchase for the typical enterprise environment carries six processors, 1GB of memory, a SCSI CD-ROM drive, and a \$91,132 price tag.—CM



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OFFICE SUITES

Taking the Suite Vertical

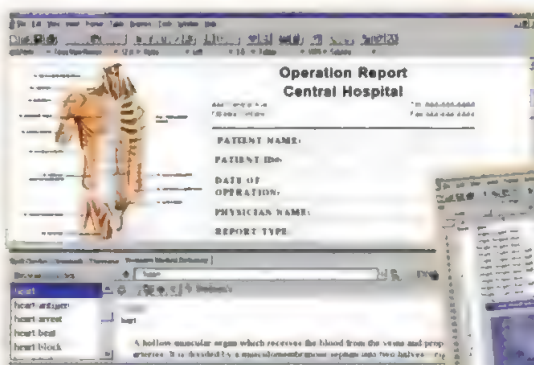
Software suites have evolved beyond simple collections of business software. Now there are suites that cater to your specific business needs.

Corel Corp. (800-772-6735, www.corel.com) is currently offering three specialized suites: **Corel WordPerfect Suite 7 for Windows 3.1—Legal Edition**

(Windows 95 and NT versions are due this summer); **Corel Office Professional 7—Medical Edition**, for Windows 95 or NT; and **Corel WordPerfect Suite 7—Construction Edition**, also for Windows 95 or NT. All three suites feature Corel's five core applications: Corel WordPerfect 7, Corel Quattro Pro, Corel Presentations, Corel Paradox, and Envoy 7.

The \$449 Legal Edition includes legal-specific enhancements to the aforementioned core applications, as well as the Corel Desktop Applications Director, and QuickTasks. It also provides case and time management modules and word processing features designed for legal professionals, including a legal spellchecker.

The \$449 Medical Edition includes all of the core applications as well as the CorelDraw engine and InfoCentral 7. Features specific to the medical community include Stedman's Electronic Medical Dictionary 3.0, with more than 100,000 medical words and terms; Stedman's Plus 4.0 spellchecker, with more than 343,000 medical and pharmaceutical terms; 20 medical master templates in Corel Presentations; and 100 new medical illustrations as well as 30 medical image watermarks.



NICHE MARKETS: Corel's medical (above) and construction editions (right).

QuickTasks and WordPerfect templates assist with specialized tasks such as keeping patient records, submitting research papers (to more than 600 medical journals), and billing forms.

For the construction industry, Corel has put together a \$449.95 suite that includes CAD and business software such as Corel Visual CADD 2.04, InfoCentral 7, and CorelFLOW 3. Additional features targeted at the construction industry include over 400 house plans in Visual CADD format, 7,000 CAD symbols, 50 title blocks, construction forms, and building specifications.

Rather than create suites for certain industries, Lotus Development Corp. (800-782-7876, www.lotus.com) has focused its efforts on developing the **Lotus Business Partner Program**, which enables third-party partners to customize any Lotus product for a client and charge their own fee. Lotus has thus far forged over 50 partnerships that allow Lotus SmartSuite to be customized to the specific needs of such niches as health care, sales and marketing, and finance. Both Corel and Microsoft provide similar customization services for their suites.

Not all specialized suites are

focused on specific types of businesses. Microsoft Corp. (800-426-9400, www.microsoft.com) has a suite dedicated to the home-office and family user. The \$109

Microsoft Home Essentials 97 includes Microsoft's Word 97, Encarta 97, Works 4.0, Greetings Workshop,

focuses on developers who use Microsoft Office to build business solutions. Both suites include Microsoft Office's fundamental applications: Word 97, Excel 97, and the Outlook 97 information manager.

The **Small Business Edition**, which streamlines the tasks associated with managing a small business, also includes Publisher 97, Small Business Financial Manager (a financial analysis tool), Automap Streets Plus, and Microsoft Internet Explorer.

The Developer Edition adds Access 97 and PowerPoint 97, as well as Visual Basic for Applications 5.0 (the

shared development environment for Office); a royalty-free runtime license for distributing Access solutions; Access and Visual SourceSafe integration tools; and a replication manager that adds data replication capabilities and ActiveX controls such as HTTP, FTP, and Gopher.—Yvonne Koulouthros

In addition to its Home Essentials suite, Microsoft offers two other dedicated suites. The \$499 **Microsoft Office 97, Small Business Edition** aims to fulfill the technology needs of small businesses, while the \$799 **Microsoft Office 97, Developer Edition**



OFFICE SUITES

Next on Deck for Corel

While Corel's specialized suites are all in Version 7, the next version of Corel's standard and professional suites are waiting in the wings. The release of Corel WordPerfect Suite 8 will be followed by the professional edition, due to ship at the end of the summer.

The \$395 **Corel WordPerfect Suite 8** comes with Corel WordPerfect 8, Corel Quattro Pro 8, Corel Presentations 8, Corel Photo House, Envoy 7 Viewer, Software Development Kit, Corel Central, and a vast selection of fonts, clip art, and photos.

Corel WordPerfect Suite 8 Professional (price not yet determined) lacks Corel Photo House, but adds Corel Paradox 8, Corel WEB. SiteBuilder, Fedex Power ship, and Corel Time Line. WEB.SiteBuilder is a basic tool for creating, editing, and publishing Web sites. Corel Central 8 is a PIM that integrates with Netscape Communicator. If you purchase the nonprofessional version of the suite before CorelCentral 8 ships, you can still receive it free of charge directly from Corel.

Both suites come with Corel's unique Barista technology, which enables you to create WYSIWYG documents for the Web. And both editions of the suite also come with Corel's new form of hands-on, interactive help: Corel PerfectExpert, which blends the suite's former help features—QuickTasks, templates, Help, and Coaches—across applications. Corel Quattro Pro 8 boasts new speed and power enhancements, including a WYSIWYG spreadsheet with a fully editable page view; and Corel Presentations 8, which lets you publish your slide shows—complete with sounds and animations—to the Web.—YK

RECAP PC Magazine last reviewed office suites from Corel, Lotus, and Microsoft in the February 18, 1997 issue; Microsoft Office 97, Professional Edition was awarded an Editors' Choice.

Trends Peripherals

19-INCH MONITORS

Free Screen Real Estate

Look around the office: Most users spend the day in front of 15- or 17-inch monitors, while the high-end 20- and 21-inch models are reserved for the art department. A 17-inch display may be a good size for traditional tasks, but for viewing two windows side by side or keeping a live Internet or TV feed on-screen while you work, this size just doesn't cut it.

The good news is that there's now a middle ground, as vendors are readying the first generation of 19-inch monitors. These units use Invar shadow mask tubes and

have prices in the same ballpark as the best 17-inch units (\$900 to \$1,300), giving you about 2 extra inches with little or no increase in footprint size.

From SAMPO Technology (888-321-4100) comes the \$895 (list) **AlphaScan 810**. This flat-square monitor has a 0.26-mm dot pitch and a maximum resolution of 1,600-by-1,200 at a refresh rate of 75 Hz.

The \$899 (list) **E090**, from Princeton Graphics (800-747-6429, www.prgr.com), has a 0.26-mm dot pitch and 1,280-by-1,024 maxi-



um resolution at 75 Hz. The unit features AART (Advanced Anti-Reflection Technology) coating and Coloright™ Technology, a color-matching control.

The **SuperScan Elite 751** (\$1,200 street), from NSA/Hitachi (800-

COLOR CORNER:
Cornerstone Imaging's Color 45/101sf.

441-4832), has a superfine 0.22-mm dot pitch and a maximum resolution of 1,600-by-1,200 at 75 Hz. It uses Hitachi's dark-tint panel and A-EA-MDF electron gun, which delivers a higher-contrast picture than traditional Invar shadow mask designs.

The **Color 45/101sf** (\$1,300 street), from Cornerstone Imaging (800-562-2552, www.corimage.com), targets business users who spend all day at their computers. It has a resolution of 1,600-by-1,200 at 81 Hz and 0.22-mm dot pitch, and it implements high-contrast glass to minimize reflection. The unit also uses Super-Focus, a new technology from Cornerstone, to deliver a razor-sharp focus.—*Toni F. Kistner*

PERSONAL SCANNERS

Color Scans, All Around

Using personal sheet-fed scanners is a convenient way to digitize documents and whatever else you can think of (from business cards to newspaper clippings), and now they scan in 24-bit color.

The **PaperPort Strobe** (\$320 street), from Visioneer (800-787-7007, www.visioneer.com), has a stylish design that encourages placing the scanner between your keyboard and monitor. Tightly integrated with Visioneer's robust scanning and file management utility PaperPort, the sleek unit can scan 300-dot-per-inch (dpi) color images at 6 pages per minute (ppm) and

monochrome images at 4 ppm. The software bundle includes Corex CardScan SE, Quicken ExpensAble, and Xerox TextBridge OCR.

With a street price of \$160, the 300-dpi **Color PageWiz**, from Microtek Lab (800-654-4160, www.microtek.com), is a bargain. This compact unit can sit at the head of the keyboard or atop a monitor, and it slips easily into a briefcase for traveling. The scanner includes a SCSI-to-parallel pass-through cable that lets you add the scanner in a SCSI chain. It scans color at 4 ppm (12 ppm for monochrome) and includes Xerox's software packages Pagis

SE and TextBridge Classic OCR.

A well-known maker of color flatbed scanners, Hewlett-Packard Co. (800-722-6538,

5-by-7 color photo at 300 dpi in 1 minute (4 ppm for monochrome), and it includes Caere's OCR OmniPage Lite and an HP



www.hp.com) enters the color sheet-fed scanner market with the **ScanJet 5s**, a 300-dpi unit that sells for \$250 (street). Its design demands a bigger chunk of desktop space than other sheet-fed scanners, although it does have a 10-page document feeder. It scans a

version of Visioneer's software package PaperPort.

Logitech Corp. (800-231-7717, www.logitech.com) is putting the finishing touches on its 300-dpi **PageScan USB** for use with the new crop of USB-enabled systems. (For more on USB, read "Getting on the USB" in Trends, April 8, 1997.) The scanner's low power needs obviate the clunky power-supply brick.

At this time, the PageScan is available only through OEMs. Like most vendors of USB peripherals, Logitech is waiting for the drivers to be in place before offering the scanner at retail. The wildcard for which everyone's waiting, of course, is Microsoft Windows 97, which has comprehensive USB drivers and is due to ship near year's end.—*TFK*

COLOR LASER PRINTERS

A Plain-Paper Rainbow

New developments in network color lasers mean that you can now print color documents—such as newsletters and presentations—on ordinary copier paper just as with monochrome laser printers.

Replacing the Color LaserJet 5 line, from Hewlett-Packard (800-752-0900, www.hp.com), is the 300-dpi **Color LaserJet 5** (\$4,000 street) and the **LaserJet 5M** (\$5,200 street). The new models cost over 30 percent less, and they use HP's CLJ5FR technology for improved speed and print quality.

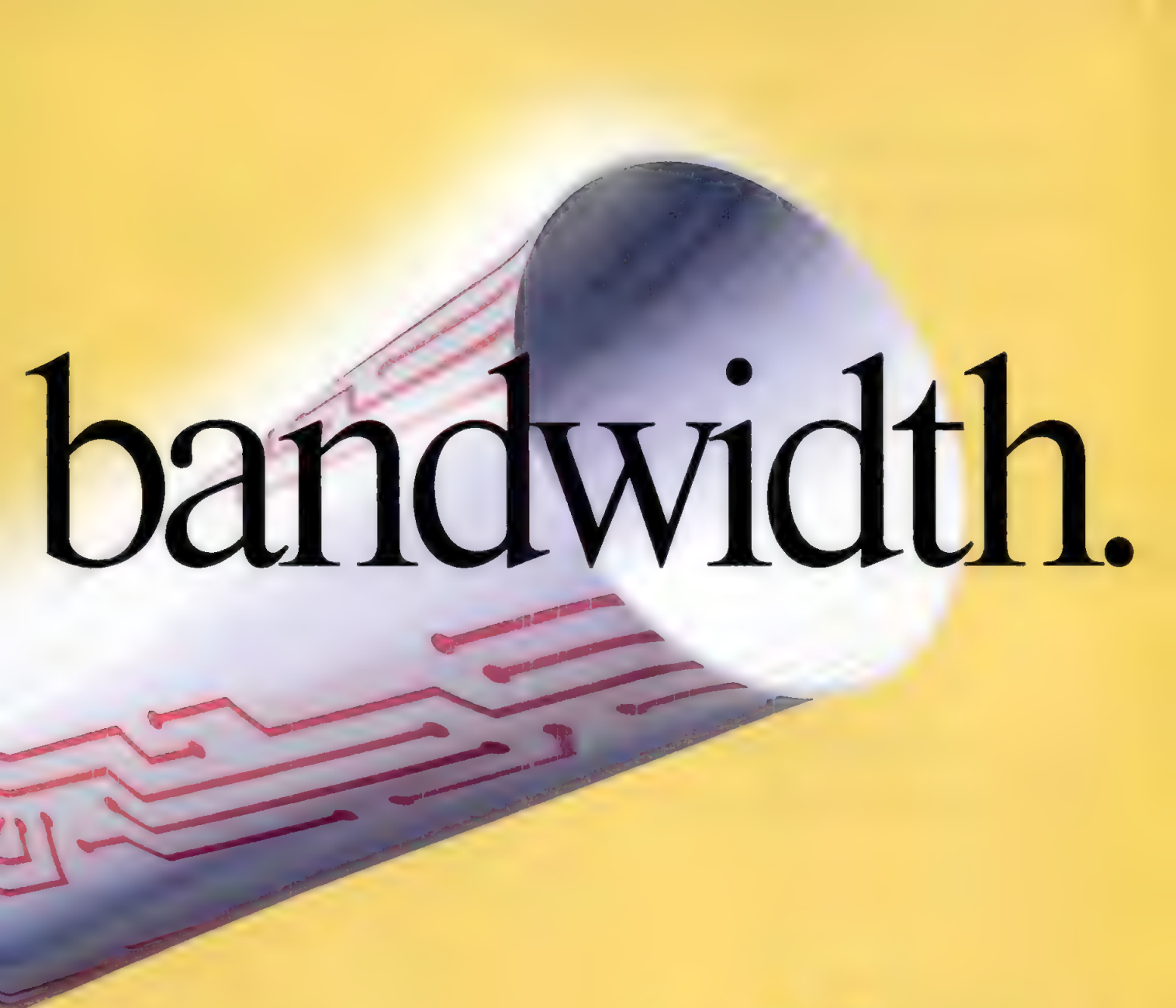


In addition, Minolta Corporation (888-264-6658, www.minoltaprinters.com) is introducing the 600-dpi **Color PageWorks**. Priced at under \$3,000 (street), Color PageWorks is a 3-ppm color laser (12 ppm for monochrome) that includes two paper-handling trays for a 400-sheet capacity.—*TFK*

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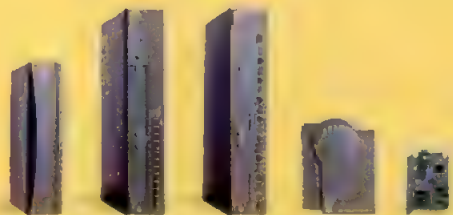


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Trends Applications Development

CONVERSION UTILITIES

Closing the Java Gap

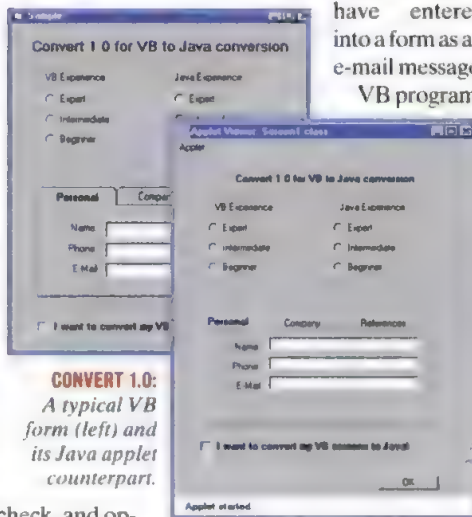
It's now easier for Microsoft Visual Basic programmers to make the jump to Java, thanks to a new wave of products and services.

Applet Designer 1.5, from TV Objects Corp. (800-858-2638, www.tvobjects.com), installs as an add-in to VB 4.0 and 5.0. The software creates a small toolbar through which you can generate Java source code (.JAV) modules from your VB form code. The \$497 Professional version contains an OpenLink JDBC driver that lets you link to databases on the Web. The \$997 Enterprise edition lets you create three-tiered Java applications and features JDBC access, repository support, and a Java-based implementation of CORBA for distributed-object

compatibility.

Look to Black Dirt Software's \$59.99 **Convert 1.0** if you want to use your Visual Basic screen designer to build Java screens (914-651-1599, www.blackdirt.com). Convert supports most basic VB controls, including labels, text-books, and lists, as well as command, check, and option buttons; newer controls, such as menus and tabs; and third-party controls like grid, masked tree, and edit. For programmers who want

to hear from their users, Convert lets you create SendMail applets that submit information you have entered into a form as an e-mail message. VB program-



CONVERT 1.0:
A typical VB form (left) and its Java applet counterpart.

mers will be on familiar ground with Halcyon Software's **BASIC 4 JAVA** (408-378-9898, www.vbix.com). Due out by sum-

mer's end (price unavailable at press time), this tentatively named, VB-compatible IDE is written mostly in Java and contains a Form Painter, a Code Editor, a Project Browser, a Menu Editor, and a source code debugger. **BASIC 4 JAVA** supports existing VB 3.0 and 4.0 project and source files, letting you open them directly into the IDE. Using the package's compiler, you can compile BASIC source and forms directly into Java bytecode, readying them for deployment. You can create Java source code with an optional CodeGen module.

As Zoologic (www.zoologic.com.au) readies its **Baja** VB-to-Java translation utility for the market, the company is offering free trial services via its Web site. Baja, slated for a late summer release, will include a translator and a collection of runtime emulation classes.—*Jay Munro*

WEB DEVELOPMENT TOOLS

All-In-One Development

Think of it as an office suite for software and Web developers. Microsoft's powerful new bundle of Internet development tools in \$1,499 **Visual Studio 97 Enterprise Edition** changes the rules for the

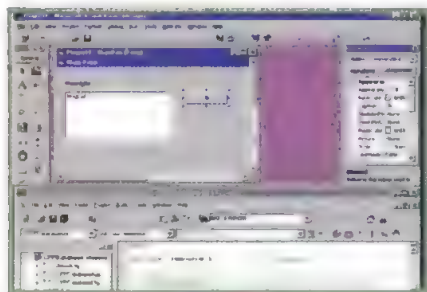
InterDev share the Development Studio interface, a command center for working with each of the tools. Higher-end developers can take advantage of both Visual C++ 5.0, with its performance enhancements, and the new, integrated support for building ActiveX Web controls. Visual J++ 1.1 is included for Java programmers.

For RAD development, you can use Visual Basic 5.0, which features compiled code and excellent ActiveX support. Visual Studio includes Visual FoxPro 5.0, so you can create traditional (and Web-enabled) database applications quickly. The Web development tool InterDev 1.0 gives HTML designers and developers control over ActiveX scripting, letting you create database-aware Web pages quickly. Visual Studio also features Visual SourceSafe 5.0 for version con-

trol, so teams of developers can share files.

For the back end, the package ships with Microsoft Transaction Server, which assists in managing database transactions, and a developer edition of SQL Server 6.5, for creating and managing SQL databases. Although Mi-

crosoft has allowed tools to coexist within a single interface before, it has never bundled so many tools together under a single umbrella. With this combination, Microsoft is expanding the market for development and programming tools.—*Richard V. Dragan*



MICROSOFT VISUAL STUDIO: Raising the bar for comprehensive tools that are delivered in a single box.

way programming tools are delivered. The recently released package includes HTML and ActiveX utilities; C++, Java, and Visual Basic compilers; version control; and extensive database support that will appeal to programmers and designers of all levels.

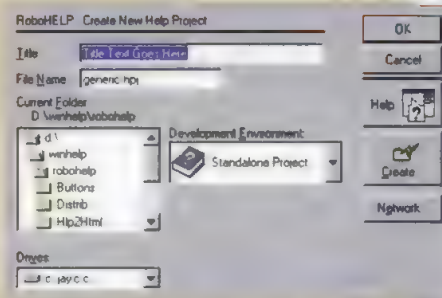
Visual C++, Visual J++, and

HELP AUTHORING TOOLS

It Ain't Over Yet

The fat lady may have sung, but development isn't over until you finish the documentation and help files. Blue Sky Software's \$499 **RoboHELP 4** (800-459-2356, www.blue-sky.com) integrates with Microsoft Word 7 and Word 97 to let developers create Windows help (for Windows 3.1, 95, and NT), HTML 3.2-based help (for both Microsoft and Netscape), user manuals, and Web sites.

You can work either in WYSIWYG or in TrueCode (.RTF-syntax) mode to create such help features as jumps, topics, buttons, contents tabs, hotspots, and pop-ups. For legacy projects and executables, you can use SmartHelp and the What's This? Help Composer to add context-sensitive help without rewriting or recompiling your code. And to stay atop of the still-evolving HTML help standard, registered users can take advantage of Blue Sky's free AutoUpdate program.—*JM*





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2010CS	166MHz	32MB	2.1GB	2010CS	166MHz	32MB	2.1GB
2010CS	166MHz	32MB	2.1GB	2010CS	166MHz	32MB	2.1GB
2010CS	166MHz	32MB	2.1GB	2010CS	166MHz	32MB	2.1GB
2010CS	166MHz	32MB	2.1GB	2010CS	166MHz	32MB	2.1GB

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MODEMS

Faster Modems (Maybe)

With promises of speedier online connections, 56-Kbps modems are all the rage. But there are caveats to consider. Your phone line's quality may prevent you from taking advantage of the technology. What's more, the 56-Kbps modems on the market use two competing, incompatible 56-Kbps signaling standards. (An industry standard should be settled by January 1998.) For now, you need to know what technology your ISP supports if you buy a 56-Kbps modem.

The first of the fast modems out of the gate are from U.S. Robotics (800-342-5877, x2.usr.com); they use the company's x2 signaling scheme. *PC Magazine's* informal testing (First Looks, May 6, 1997) showed connection speeds as high as 52 Kbps for U.S. Robotics' Courier x2 and Sportster. Unfortunately, we also frequently connected at just 33.6 Kbps.

U.S. Robotics has set up a toll-free number to test whether your phone line supports x2 transmission. Dial 888-877-9248 using terminal software and type "Line Test" when prompted for your name. U.S. Robotics admits the test is not 100 percent accurate, but when we tried it from our offices in New York—where we achieved at most a 26.4-Kbps connection using x2 modems—it predicted that the line could not support x2.

Other vendors selling x2-compatible modems include Logicode Technology (800-735-6442, www.logicode.com), which offers the **Quicktel** line of modems. The units cost \$170 to \$390 (street), with the higher-end models providing telephony features. Logicode lets users mail in any modem and receive a credit toward an x2 Quicktel modem.

Global Village Communication

(800-736-4821, www.globalvillage.com) enters the x2-compatible market with its **TelePort 56** modems; the internal model sells for \$160 and the external one for \$170 (street prices). Cardinal Technology (717-293-3000, www.cardtech.com) is also shipping x2-compatible modems. Prices for the **Connecta**

line—which encompasses internal, external, and telephony models—range from \$160 to \$220 (street).

The other 56-Kbps technology, which is called K56flex, was developed jointly by Lucent Technologies and Rockwell Semiconductor Systems. Just as with x2, your success with it will depend on your phone lines and whether your online service provider supports it.

The first K56flex product is

from Motorola Information Systems Group (508-261-4000, www.mot.com), whose **Modem-Surfr 56** comes in a \$160 (street) internal model and a \$180 (street) external device. Motorola is also offering internal and external versions of the **VoiceSurfr 56** (street prices are \$180 for the internal, \$200 for the external). Users registering for Motorola's buyer-protection program Tidal Wave will receive upgrades to a 56-Kbps standard.

ActionTec Electronics (800-797-7001, www.actiontec.com) offers the K56flex-compatible **56K Internal Fax Modem** (\$150 street) and the

DataLink 56K PCMCIA (\$200 street). And the K56flex entries from Zoom Telephonics (800-666-6191, www.zoomtel.com) include the **Zoom/FaxModem 56K** (internal, \$170 street) and the

Zoom/FaxModem 56Kx (external, \$190 street). Best Data (800-632-2378, www.bestdata.com) weighs in with the **Smart One 56K** internal and external modems (street prices range from \$150 to \$180).

From Diamond Multimedia Systems (800-468-5846, www.diamondmm.com) comes the **SupraExpress**

56e, a \$190 external model, and the **SupraExpress 56i**, a \$170 internal unit (both are K56flex-compatible). The **Supra-Express 56e Sp** (external) and **56i Sp** (internal) are each equipped with a speakerphone; the 56e costs \$200 and the 56i is \$190. (All prices are street prices.)

Not to be left out is Hayes Microcomputer Products (770-441-1617, www.hayes.com). In late March, it began shipping the K56flex-compatible **Accura** modem line (street prices range from \$150 to \$220) and the **Accura 56K PC Card** (\$210 street).

—Jennifer L. Anderson



MODERN MADNESS: Logicode's Quicktel (left), ActionTec's DataLink 56K PCMCIA (bottom) and Global Village's TelePort 56 (above).



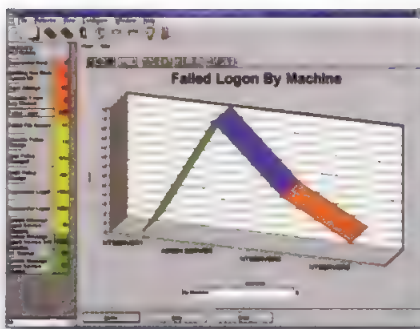
NETWORK SECURITY

Network Burglar Alarms

As companies do more and more business on the Internet, their networks are facing an increasing risk of intrusion by hackers. But there are network security products that can let you know when hackers slip past your firewall and tell you what they are doing. Internet Security Systems (800-776-2362, www.iss.net) and Intrusion Detection (800-408-6104, www.intrusion.com) have both released security solutions for Microsoft Windows NT-based networks.

The \$4,995 (list) RealSecure NT 1.0, from ISS, monitors your network by analyzing packet traffic for over 70 known attack pat-

terns. When it detects an intrusion, it automatically logs the hacker's activity, alerts the network administrator, and can ter-



TO SERVE AND PROTECT: Kane Security Monitor 1.0 keeps track of repetitive failed log-on attempts.

minate the connection. In addition, RealSecure monitors suspicious network traffic based on the activity's source, destination, and service type.

Intrusion Detection's Kane Security Monitor 1.0 (list pricing starts at \$995) takes a different tack. Using artificial intelligence, KSM searches Windows NT's event logs for potential security breaches, such as repeated failed log-on attempts, excessive privilege granting, or Administrative ID abuse. It also comes with a feature known as a "damage index," which informs you of the damage a hacker could wreak on a specific ID.—Robert Daly

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STATISTICA (automatically configures itself for Windows 95/NT [long file names, etc.] or 3.1) ■ A complete data analysis system with thousands of on-screen customizable, presentation-quality graphs fully integrated with all procedures ■ Comprehensive Windows support, OLE (client and server), DDE, customizable *AutoTask* toolbars, pop-up menus ■ Multiple data-, results-, and graph-windows with *data-graph* links ■ The largest selection of statistics and graphs in a single system; comprehensive implementations of: Exploratory techniques with advanced brushing; multi-way tables with banners (presentation-quality reports); nonparametrics; distribution fitting; multiple regression; general nonlinear estimation; stepwise logit/probit; general ANCOVA/MANCOVA; variance components; stepwise discriminant analysis; log-linear analysis; confirmatory/exploratory factor analysis; cluster analysis; multidimensional scaling; canonical correlation; item analysis/reliability; correspondence analysis; survival analysis; a large selection of time series modeling/forecasting techniques; structural equation modeling with *Monte Carlo* simulations, and much more ■ On-line *Electronic Manual* with comprehensive introductions to each procedure and examples ■ Hypertext-based *Stats Advisor* expert system ■ Workbooks with multiple *AutoOpen* documents (e.g., graphs, reports) ■ Extensive data management facilities (fast spreadsheet of unlimited capacity with long formulas, *Drag-and-Drop*, *AutoFill*, *Auto-Recalculate*, split-screen/variable-speed scrolling, advanced Clipboard support, DDE links, hot links to graphs, relational merge, data verification/cleaning) ■ Powerful *STATISTICA BASIC* language (professional development environment) with matrix operations, full graphics support, and interface to external programs (DLLs) ■ Batch command language and editable macros, flexible "turn-key" and automation options, custom-designed procedures can be added to floating *Auto Task* toolbars ■ All output displayed in *Scrollsheets* (dynamic, customizable, presentation-quality tables with instant 2D, 3D, and multiple graphs) or word processor-style report editor (of unlimited capacity) that combines text and graphs ■ Extremely large analysis designs (e.g., correlation matrices up to 32,000x32,000, virtually unlimited ANOVA designs) ■ Megafile Manager with up to 32,000 variables (8 Mb) per record ■ Unlimited size of files; extended ("quadruple") precision; unmatched speed ■ Exchanges data and graphs with other applications via DDE, OLE, or an extensive selection of file import/export facilities (incl. *ODBC* access to virtually all data bases and mainframe files) ■ Hundreds of types of graphs, incl. categorized multiple 2D and 3D graphs, ternary 2D/3D graphs, matrix plots, icons, and unique multivariate (e.g., 4D) graphs ■ Facilities to custom-design new graph types and add them permanently to menus or toolbars ■ On-screen graph customization with advanced drawing tools (e.g., scrolling and editing of complex objects in 32x real zoom mode), compound (nested) OLE documents, *Multiple-Graph Autolayout Wizard*, templates, special effects, icons, page layout control for slides and printouts; unmatched speed of graph redraw ■ Interactive rotation, perspective and cross-sections of 3D displays ■ Large selection of tools for graphical exploration of data: extensive brushing tools with animation, fitting, smoothing, overlaying, spectral planes, projections, layered compressions, marked subsets ■ Price \$995.

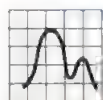
Quick STATISTICA (for Windows) ■ A subset of *STATISTICA*; comprehensive selection of basic statistics and the full analytic and presentation-quality graphics capabilities of *STATISTICA* ■ Price \$495.

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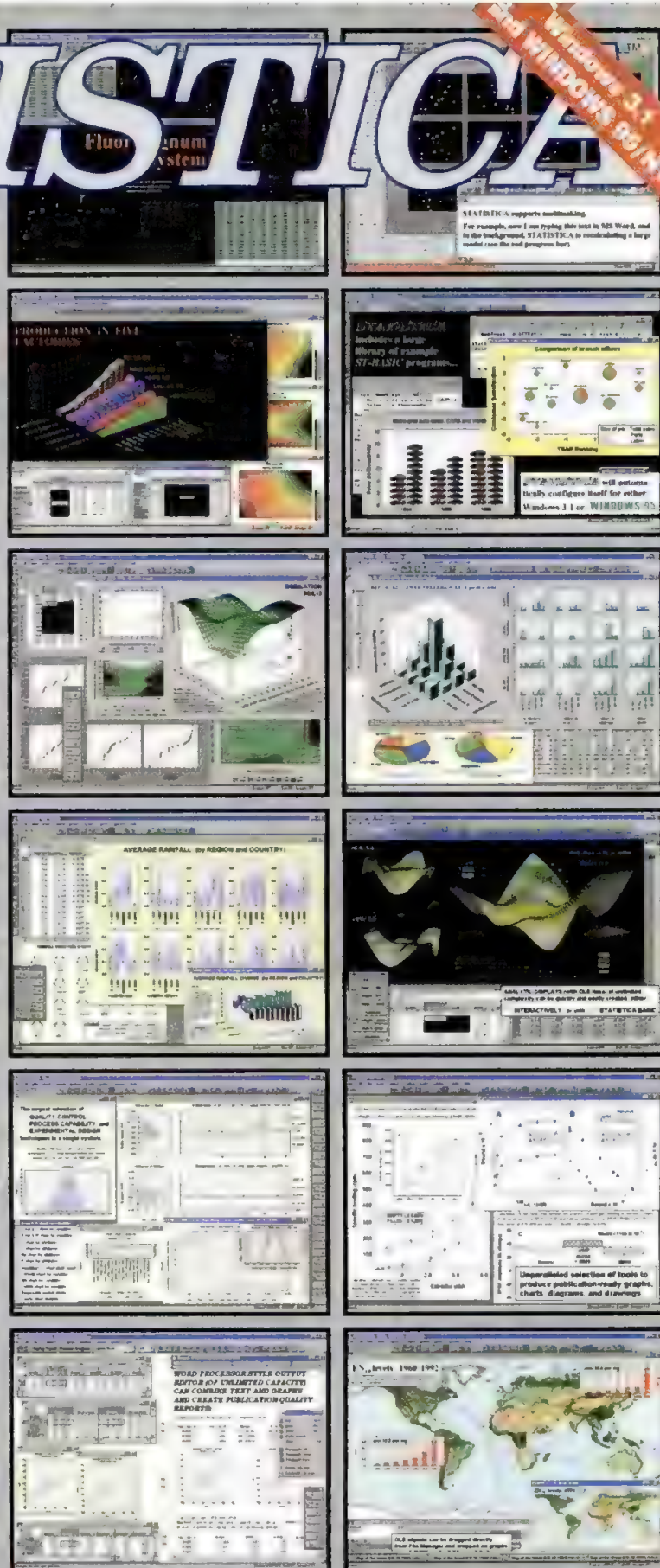
STATISTICA has received the highest rating in EVERY comparative review of statistics software in which it was featured, since its first release.



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First Looks



David Meets Goliath

AMD's K6 processor is a worthy competitor to the Pentium standard.—By Cade Metz

For the first time in 25 years of microprocessor development, a new Intel chip is in a competitive fight. Introduced this month, the 233-MHz version of Intel's Pentium Processor with MMX Technology is poised to go head-to-head with AMD's new K6, a CPU that matches the venerable Pentium on performance while beating it on price.

Here we review a quartet of 233-MHz MMX Pentium PCs along with four inaugural K6 machines. The Pentium systems belong to four companies that typically receive new Intel hardware as soon as it becomes available: Dell Computer Corp., Gateway 2000, NEC Computer Systems Division, and Quantex Microsystems. On the K6 side of the fence, we find less familiar names: CyberMax Computer and Nova Computers sent us 200-MHz machines, while Poly-

well Computer and TigerDirect provided 233-MHz systems.

INSIDE THE PENTIUM

The Pentium Processor with MMX Technology was introduced this past January. It was the first Intel chip to be manufactured on the 0.35μ CMOS process, which affords a lower core voltage and lower power consumption.

With its 32K of L1 cache, the chip improved on the performance of the original Pentium (which had only 16K of L1 cache) by 10 to 20 percent. The chip's true innovation, however, was the addition of MMX Technology—57 new x86 instructions designed to enrich and accelerate multimedia functions.

The 233-MHz chip differs from its predecessors only in clock speed. It is manufactured on the same process, integrates the same L1 cache, uses the same

MMX unit, and has the same 2.8-volt core. Setting an initial price of \$594 (per CPU in quantities of 1,000), Intel is aiming the new chip solely at the consumer market, and it is leaving the business environment to the Pentium II.

INSIDE THE K6

Though it plugs into the same socket as the MMX Pentium, the K6 is a more complex processor. Manufactured on AMD's 0.35μ Silicon Technology process, the K6's 162mm² die contains 8.8 million transistors—almost twice as many as the MMX Pentium. Most of those additional transistors are used in a 64K L1 cache.

The K6 is also equipped with MMX. Since Intel went public with the instruction set in May 1996 (to encourage software development), AMD could easily design its own MMX implementation.

At \$469 per part (in 1,000-unit quantities), the 233-MHz K6 is \$130 cheaper than the MMX Pentium. The 166- and 200-MHz CPUs are even less expensive: \$244 and \$349, respectively. The K6's low price and aptitude for Microsoft Windows 95 applications make it a very attractive consumer processor. It's also great competition for the MMX Pentium.

PERFORMANCE RESULTS

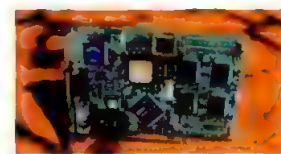
During our Windows 95 testing, both 233-MHz K6s and even the 200-MHz CyberMax K6 posted higher scores than all four MMX Pentiums on our ZD Business Winstone 97 test—a measure of overall system performance. To be fair, however, these scores were only a few points apart, so in the grand scheme of things, we consider the chips to be on par in terms of applications performance under Windows 95. In other words, the 233-MHz Polywell Poly K6233Mx garnered a

INSIDE

PRIME TIME

TUNE UP:

Helix Software's Nuts & Bolts reaches the A-list of utility packages. See page 73.



MULTIDIMENSIONAL:

Matrox's Millennium II and Diamond's Fire GL 1000 give the graphics pro a choice between 2-D and 3-D. See page 58.



SMOOTH

BEGINNING:

Three new programs make it a snap to install software from the Web. See page 76 for the full story.



PHOTO IMAGERY:

Canon, Casio, Epson, and Nikon offer affordable digital cameras. See page 62 for the story.

More Products Reviewed...

Search'97 Personal for Netscape Navigator and Microsoft Internet Explorer..66
MatLab 5.0.....66
Blaze Web Performance Pack 1.1.....70
Crystal Ball 4.0.....70

First Looks



Dimension XPS M233s

Direct price: With 233-MHz MMX Pentium, 32MB SDRAM, 512K L2 cache, 6.4GB hard disk, max 16X CD-ROM drive, 17-inch monitor, \$3,199

Dell Computer Corp., Austin, TX; 800-812-

3355, 512-338-4400

www.dell.com

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likely that an end user would be able to discern the difference.

Other components such as hard disks and graphics cards have a big impact on performance; in some cases, even more so than the processor itself. TigerDirect, for example, equipped its K6/233 with a 10,000-rpm Seagate Cheetah Ultra SCSI hard disk, a component that's key to good performance. Using this drive, the Tiger machine racked up the top Winstone and Disk WinMark scores.

Drivers are also very important, as shown by the Nova 200-MHz PK6-2002. This machine got trounced on our benchmark tests because of its graphics card driver: Nova shipped the machine to us with a generic S3 driver specifically tuned to its Diamond Stealth 3D 2000 accelerator. Because we tested machines in PC Labs as the vendor shipped them to us, the Nova machine's scores are very low. Nevertheless, during anecdotal testing with the proper driver installed, the scores went up substantially.

Our Windows 95 MMX testing was inconclusive. We ran three different 15MB filters under Adobe Photoshop 4.0, but

with system memory set at 32MB this test is somewhat disk-bound. So it was no surprise that the TigerDirect K6 machine—with its Cheetah drive—delivered the fastest scores.

THE BOTTOM LINE

Despite its performance, the K6 has yet to be adopted by a major PC manufacturer. If one of the top five vendors starts up, the rest may soon follow. Until this happens, buyers will have to settle for K6 systems from smaller, low-profile companies.

Given that performance is a relative wash, we believe that you wouldn't go wrong purchasing any one of these machines. If you don't feel comfortable buying a PC from a vendor that's not a household name, the Pentium/MMX may be the better choice. But if what's inside the box counts more than the label on the outside, shop around.

Dell Computer Corp.

Dimension XPS M233s

Once again, Dell has fashioned an optimal machine for the small- and medium-business set. In addition to being the leading Pentium-based performer in our

roundup, the \$3,199 Dimension XPS M233s offers Zip drive storage, splendid sound, and one of the most adept mainstream graphics cards on the market: the Matrox Millennium II.

The Dimension's side panel holds a single thumbscrew; after a few turns to loosen it, the panel easily slides off. Once inside, you'll find one open 5.25-inch drive bay and a pair of 3.5-inch bays. Equipped with a 33.6-Kbps modem, a Creative Labs SoundBlaster AWE32 audio upgrade card, and the Millennium II, the system has two open PCI slots and one open ISA slot.

The system's motherboard integrates Intel's 430VX chip set rather than the new 430TX PCiset (which inherently supports UltraDMA). Yet this board does offer a 233-MHz MMX Pentium, 32MB of synchronous DRAM, 512K of L2 cache, and two USB ports.

The Dimension posted higher scores than every other Pentium system on our Winstone test, but it was bettered by every K6 system save the Nova. Although it had the highest CPUmark₁₆ result in our roundup, it had the lowest CPUmark₃₂ score.

SUMMARY OF FEATURES

Pentium and K6 PCs

PC MAGAZINE
EDITOR'S CHOICE

PC MAGAZINE
EDITOR'S CHOICE

	CyberMax PowerMax A55 200MX	Dell Dimension XPS M233s	Gateway 65-233	NEC PowerMate Performance	Nova PK6-2002	Polywell Poly K6233Mx	Quantex QPS/233 SM-4X	TigerDirect K6/233
Price of tested configuration (32MB RAM, 512K L2 cache, 17-inch monitor)	\$2,049 (direct)	\$3,199 (direct)	\$2,389 (direct)	\$3,120 (street)	\$2,649 (direct)	\$2,490 (street)	\$3,099 (direct)	\$4,278 (direct)
Processor	K6/200	Pentium MMX/233	Pentium MMX/233	Pentium MMX/233	K6/200	K6/233	Pentium MMX/233	K6/233
Memory type	SDRAM	SDRAM	EDO DRAM	EDO DRAM	SDRAM	SDRAM	EDO DRAM	EDO DRAM
Chip set	SiS 5571	Intel 82430VX	Intel 82430VX	Intel 82430HX	Intel 82430TX	Intel 82430TX	Intel 82430TX	VIA 580VP
Graphics adapter	Matrox Millennium	Matrox Millennium II	STB Nitro	Diamond Stealth 3D 2000	Diamond Stealth 3D 2000	Diamond Stealth 3D 2000	STB Nitro	Matrox Millennium
Memory and type	4MB WRAM	8MB WRAM	4MB EDO DRAM	4MB EDO DRAM	4MB EDO DRAM	4MB EDO DRAM	4MB EDO DRAM	8MB WRAM
Hard disk	IBM OAA-33240	IBM DHEA-36480	Quantum Fireball TM3840A	Quantum Fireball ST	Quantum Fireball TM3840A	Maxtor 85120 A8	Western Digital Caviar 34000	Seagate 34501W
Capacity and interface	3.2GB ATA-3	6.1GB Fast ATA-3	3.8GB Fast ATA-2	4.3GB Ultra ATA	3.8GB Fast ATA-2	5.1GB ATA-3	4GB EIDE	4.3GB Ultra Wide SCSI
CD-ROM drive	Toshiba XM-6002B	NEC 285	Toshiba XM-6002B	NEC 285	Toshiba XM-5702B	Matsushita CR-584	Toshiba DVD SD-M1002	Sanyo CRD-820P
Warranty (parts/labor)	3 years, 1 year	3 years, 1 year	3 years, 3 years	3 years, 3 years	3 years, 3 years	3 years, 5 years	3 years, 1 year	1 year, 1 year
On-site service (one year)	Included	Included	Included	Included	\$50	\$75	Included	Included

Editors' Choice

- Pentium: Dell Dimension XPS M233s
- K6: CyberMax PowerMax A53 200MMX



The good news about this group of eight Pentium/MMX and K6 PCs is that you really can't go wrong with any one of them. All performed fairly

well on our benchmark tests (save the Nova, whose performance can easily be boosted with the installation of the proper graphics driver) and all come equipped with the necessary hardware to get you going. We did select two, however, that stand just above the crowd, and we award these two our Editors' Choice.

On the Pentium side of the fence, our Editors' Choice is the \$3,199 Dell Dimension XPS M233s. Like many of its predecessors in the Dimension XPS line,

this machine was a top-notch performer, and it comes loaded with great hardware. Inside the unit's screwless mini-tower case, you'll find a capacious 6.1GB hard disk, a new Matrox Millennium II graphics board with 8MB of WRAM, an Iomega Zip drive, a max16X CD-ROM drive, and a 33.6-Kbps modem. Audio chores are handled adeptly by a Creative Labs Sound Blaster AWE32 hooked to a pair of Altec Lansing speakers with matching subwoofer.

On our benchmark tests, the Dell ma-

chine led the Pentium pack. It posted the highest ZD Business Winstone 97 and Graphics WinMark 97 numbers of the group, as well as the best Disk WinMark score.

Of the K6 machines here, we liked the CyberMax PowerMax A53 200MMX. This PC is an incredible bargain: For only \$2,049, you get a fully equipped, 200-MHz K6 system that performs like a 233. It comes well stocked with some great hardware. Inside the box, you'll find a 33.6-Kbps modem, a max16X CD-ROM drive, a 3.2GB hard disk, and a 4MB Matrox Millennium graphics board. These components paid off for the PowerMax on our benchmark tests: Even though its processor is only a 200-MHz (in a field of 233s) its scores rivaled the best of both the Pentiums and the K6s.

CyberMax completes this package with a 17-inch Mag InnoVision monitor and Altec Lansing speakers with subwoofer.

Largely the result of the Millennium II and its 8MB of WRAM, the Dimension's Business Graphics WinMark score bettered all systems save the TigerDirect K6, whose scores are skewed by a 10,000-rpm hard disk. The Dimension uses a 6.1GB IBM hard disk.

Such brilliant graphics are accompanied by equally brilliant audio. The aforementioned AWE32 sound card is augmented by a pair of Altec Lansing speakers and a matching subwoofer. Dell also includes a microphone for sound recording.

In addition to an NEC max16X CD-ROM drive, Dell includes a 17-inch Sony Trinitron monitor and an Iomega Zip drive. The system comes with one Zip cartridge standard, but another two can be had for an additional \$29.

The Dimension's only drawback is its relatively poor MMX performance. Despite adept graphics-card and overall system aptitude, its times on our Adobe Photoshop tests were the slowest in this roundup.

Gateway 2000 Inc.

Gateway G5-233

At \$2,389, the Gateway G5-233 is the least expensive Pentium system in our roundup. The vendor keeps the price down in part by including a low-cost hard disk: At 3.8GB it's quite spacious, but at a rotational speed of 4,500 rpm it's a bit slower than the competition. Gateway does offer an adept CD-ROM drive with the G5-233, as well as a 56-Kbps modem. System performance should get even better when the company adopts an UltraATA hard disk this summer.

The contoured G5-233 mid-tower is both attractive and practical. The chassis can be easily retracted after the removal of two thumbscrews, and all rear ports are color-coded to match corresponding cables.

The system is built around a 233-MHz MMX Pentium, Intel's 430VX chip set, 512K of L2 cache, and 32MB of EDO DRAM. An STB Nitro graphics card with 4MB of EDO DRAM and an Ensoniq AudioPCI (identical to the one the Cyber-

Max system reviewed here) each use a PCI slot, while a Gateway Telepath 56 X2 modem plugs into one of the

system's ISA slots. This leaves one PCI, one ISA, and one shared slot for expansion.

Although three available 3.5-inch bays are internally situated, a small plastic door in front of the system pops off to reveal a pair of front-accessible 5.25-inch bays. Just above this door is a slit in the front panel that leads to a 1.44MB floppy disk drive.

Equipped with a 4,500-rpm Quantum Fireball hard disk, the G5-233 produced average scores across our benchmark tests, except for a below-average Disk WinMark result. Conversely, its CD-ROM WinMark 97 score—attributable to a max16 Toshiba CD-ROM drive—was the highest in this review.

The machine's MMX results were well above average, bettered overall only by the NEC and the TigerDirect PCs.

The G5-233 also offers two USB ports, a standup microphone, and a pair of Altec Lansing speakers. If you're looking for an affordable 233-MHz Pentium/MMX machine from a well-established source, the Gateway G5-233 is a great choice.



First Looks

NEC Computer Systems
Division

PowerMate Performance

NEC's \$3,120 PowerMate Performance is unique in this group of home and SOHO-oriented MMX PCs. With its adept system management fea-



PowerMate Performance

Street price: With MMX Pentium/233, 32MB of EDO DRAM, 512K of L2 cache, 4.3GB hard disk, max16X CD-ROM, 17-inch monitor, \$3,120

NEC Computer Systems Division, Mountain View, CA; 800-300-4036, 500-254-0300

www.nec.com

Circle 418 on reader service card.

tures, this DMI-compliant system is unquestionably earmarked for the corporate LAN. The PowerMate's strong performance and high-quality NEC monitor make it an even more attractive buy.

Within this squat midtower, an Intel motherboard integrates Intel's 430HX chipset, 512K of L2 cache, 32MB of EDO DRAM, and a 233-MHz MMX Pentium Processor. Using these core components, a 5,400-rpm 4.3GB Ultra ATA hard disk, and a Diamond Stealth graphics card with 4MB of EDO DRAM, the machine delivered average to above-average test scores.

The PowerMate's Winstone result was the second highest among Pentiums, but it trailed each K6 machine save the Nova. MMX scores trailed only those of the TigerDirect, whose expensive 10,000-rpm hard disk provided a distinct advantage.

The system motherboard also offers on-board 16-bit Creative Labs audio and two USB ports. It integrates ATI Rage graphics and 2MB of SGRAM as well, but an upgrade to 4MB of graphics memory requires the addition of the aforementioned Diamond card. Other major com-

ponents include a max16X CD-ROM drive and a 17-inch NEC MultiSync monitor.

NEC also outfits the machine with its Desktop Manageability solution. This DMI-compliant package includes Intel's LAN-Desk, McAfee's VirusScan, WebScan, and a Magic Eye motherboard ASIC. The latter keeps track of numerous system environmental factors, including internal temperatures and fan speeds.

After the removal of three thumbscrews, the chassis cover slides off to reveal an expansion slot riser card, which offers two open PCI slots and two ISA slots. Only two external 5.25-inch bays are available for expansion, but the PC offers six SIMM slots and an infrared port.

The PowerMate lives up to its name, providing a high level of performance and features for the price. It would be a good fit either as a business PC or a well-stocked personal machine.

Quantex Microsystems

Quantex QP5/233 SM-4X

With the QP5/233 SM-4X from Quantex Microsystems, the defining feature is not its 233-MHz MMX Pentium. This \$3,099 home system features a



Quantex QP5/233 SM-4X

Direct price: With MMX Pentium/233, 32MB of EDO DRAM, 512K L2 cache, 4GB hard disk, DVD drive, 17-inch monitor, \$3,099

Quantex Microsystems, Somerset, NJ; 800-780-9001, 908-953-4108

www.quantex.com

Circle 419 on reader service card.

DVD drive, along with ample multimedia hardware and a generous software bundle. The QP5/233's benchmark test scores were somewhat lower than the other machines here, but its strengths lie elsewhere.

BENCHMARK TESTS

Pentium and K6 PCs

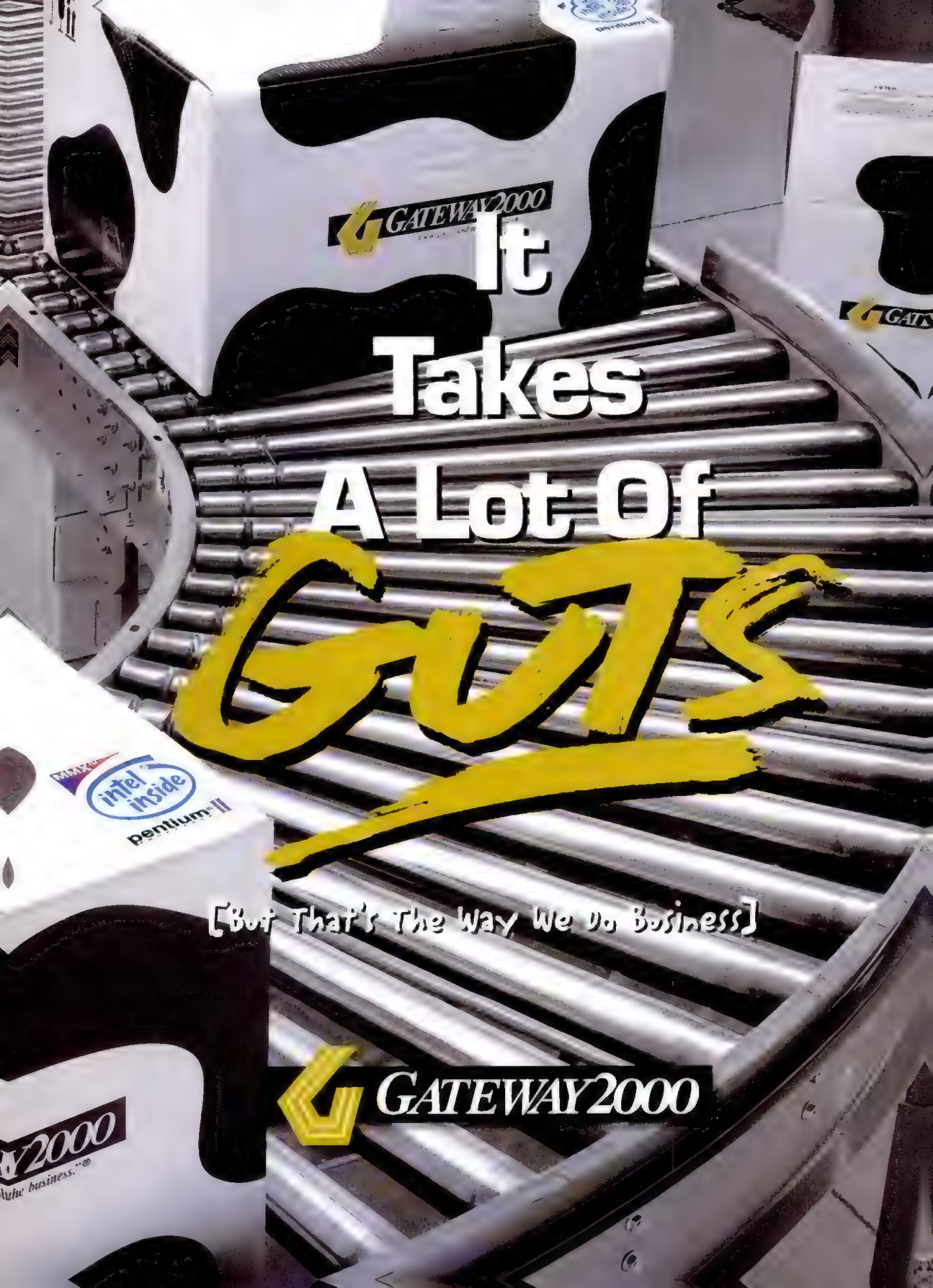


AMD's K6 processor is a worthy competitor to Intel's latest Pentium MMX processors. The CPUs are on a par on Windows 95 applications tests. In fact, these benchmark test results are more illustrative of how important other system components are. The TigerDirect

K6/233, for example, includes a 10,000-rpm Seagate Cheetah Ultra SCSI hard disk. It yielded great results on the disk tests and the disk-intensive Photoshop MMX tests. On the other hand, Nova set up its K6 system with a suboptimal video driver that hamstrung its Diamond Stealth graphics card.

▲ Higher scores represent better performance. ▼ Lower scores represent better performance. Bold type denotes first place.	ZD Business	ZD Business	ZD Business Disk			ZD CD-ROM	PHOTOSHOP 4.0*		
	Winstone 97	Graphics	WinMark 97			WinMark 97	Gaussian	Facet	Unsharpen
	Score ▲	Score ▲	Thousands of bytes/sec ▲	Score ▲ ₁₆	Score ▲ ₃₂	Thousands of bytes/sec ▲	Seconds ▼	Seconds ▼	Seconds ▼
Dell Dimension (Pentium MMX/233)	47	98	1,130	472	439	1,080	40.6	37.4	30.1
Gateway G5-233 (Pentium MMX/233)	45	83	811	470	456	1,350	27.1	23.5	15.1
NEC PowerMate (Pentium MMX/233)	46	86	1,020	466	459	1,040	26.7	22.2	17.0
Quantex QP5/233 (Pentium MMX/233)	42	77	883	451	443	475	32.3	35.0	30.5
CyberMax PowerMax (K6/200)	48	93	1,110	418	498	1,320	30.8	27.3	20.5
Nova PK6-2002 (K6/200)	40	52	812	403	488	1,130	36.6	32.1	29.2
Polywell Poly K6233Mx (K6/233)	49	80	1,310	468	565	1,130	29.0	24.7	19.5
TigerDirect K6/233 (K6/233)	51	99	1,540	454	517	1,090	21.6	18.7	12.2

* 24-bit color

A black and white photograph of a Gateway 2000 computer case being shredded by a metal roller mill. The case is white with black accents and features the Gateway 2000 logo and an Intel Inside Pentium II logo. The mill consists of several horizontal metal rollers that are crushing the case. The text "It Takes A Lot Of" is overlaid in white, bold, sans-serif font. The word "GUTS" is written in large, yellow, stylized, hand-painted letters across the middle of the image.

It
Takes
A Lot Of

GUTS

[But That's The Way We Do Business]

The Gateway 2000 logo, featuring a stylized yellow 'G' made of two overlapping shapes.

GATEWAY2000

Computer Shopper readers agree — we've blown them away for 6 years running! Best Buy awards keep flying in the door.

BUCKING

TRENDS

Gateway Does It Again

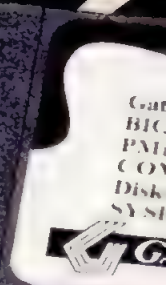
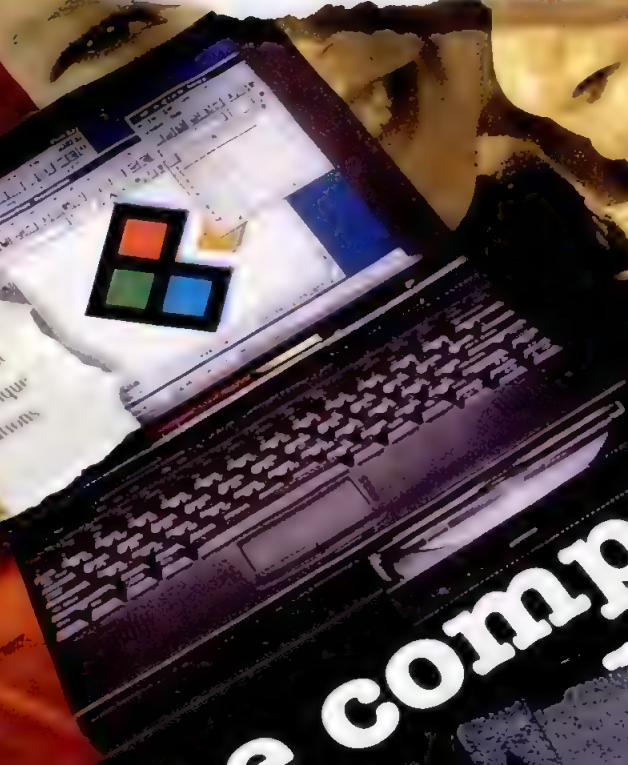
Last fall Gateway broke away from the pack and launched the Intel Pentium Pro processor into the home PC market bringing 32-bit processing to the masses. People around the globe took advantage of the opportunity and beefed up their home computing. (Sorry Gateway, no pun intended.)

Now Gateway's doing it again. Main Street U.S.A. will have equal access to Intel's newest technology, the power-packed **Pentium II processor**. While some industry leaders are holding back, waiting for Pentium II processors to take off in the workplace, Gateway 2000 rocks the consumer world. More power to them. **1**

Gateway 2000 computer. Any of technical support available folks are on call for the day, every day of the week. Our support representatives are dedicated to the greatest service and support "rewards" are kept up to date on the latest computer technology, so they can answer your questions with ease. Major account and corporate Gateway customers even have their own support team assigned specifically to troubleshoot their unique situations.



More computing & more



1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Foldout slip-sheet



Inverted Foldout slip-sheet

Folded edge of the page

1. Open the foldout page

2. Insert this sheet with

1. Front side touching the free page

2. Arrow pointing to the fold

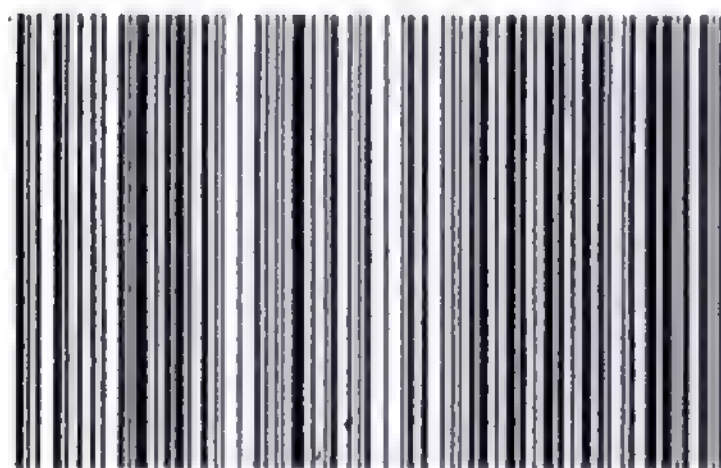
3. Slice the folded edge

4. Close the page and slip-sheet



1. Follow instructions on the other side

Inverted Back



Gbs5lipBack-0018

Back

1. Follow instructions on the other side



Leading the world in convergence technology,
we created the Destination™ Big Screen PC/TV, a
whole new computer category! It's tomorrow's
system today.



Quality Service

As the owner of a Gateway
you have access to an array
of staff. These knowledgeable
staff are available to you every hour of
the day. And they're on hand to provide
technical support and product
information.

Removable Storage Kings!
First to standardize CD-
ROM drives on desktops in
'94, sold CD-recordable
drives in '96; led the
way with modular CD-ROM
drives on all Gateway
Solo™ portables in
and now we offer
and Jaz® drives.

GUTSY

SYSTEMS

[Powered By Pentium® II Processors]

No compromises here. Gateway 2000 always has the hottest technology — now it's Intel's next-generation Pentium® II processor. Speeds up to 266MHz dish out high-powered 32-bit performance while extra cache on the processor cranks up the raw horsepower. MMX™ technology punches up your experience, taking MMX technology-enhanced software to levels of performance that will rock your multimedia world. The wait is over! Both MMX technology and the power of 32-bit processing are yours with Pentium II processors. We'll custom build your dream machine with a Pentium II processor *and* all the extras.

TelePath® Fax Modem for Windows, x2 Technology upgradeable. Call for details on how x2 Technology can shift your desktop modem into high gear. Pre-installed Web browser and utilities get you on-line fast. Now nothing can slow you down.

Boston Acoustics High-Fidelity 3-Piece Speaker System gives you next-generation audio without the chip on the G6-266XL.

Massive Storage: New processor, screaming modem, hi-fi sound — don't leave out the cavernous storage. You'll want a **huge hard drive** to store all your system's software fuel. Choose the monstrous 6.4GB 10ms EIDE hard drive. The big daddy of the bunch is a 9GB 8.2ms Ultra Wide SCSI-2 hard drive delivering data at up to 124MB/second burst throughput.

Powerful Performance

Feed your insatiable appetite for technology. From the monster muscle XL machines to our workhorse systems, we have PCs with guts at a price you can afford. Make no compromises. Call Gateway for your Pentium II processor-based system today!



[Our G6-266XL is loaded to the max, including a huge monitor with a 19.7 inch viewable area and the Boston Acoustics High-Fidelity 3-Piece Speaker System.]

PENTIUM® II PROCESSOR SYSTEMS

[This is what you've been waiting for!]

Gateway G-Series Multimedia Systems

G6-266XL

- Intel® 266MHz Pentium® II Processor with 512K Cache
- 64MB EDO DRAM
- Vivitron®1100 .28dp Monitor (19.7" viewable area)
- STB® ViRGE™/GX 4MB, 3-D 64-Bit PCI Graphics
- 9GB 8.2ms Ultra Wide SCSI-2 Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
- ▶ TR4 SCSI 4GB Tape Backup Drive
- Ensoniq® Wavetable Sound Card
- Boston Acoustics High-Fidelity 3-Piece Speakers
- TelePath® Fax Modem for Windows, x2™ Technology Upgradeable*
- Tower Case
- 104* Keyboard & MS® IntelliMouse™
- Microsoft® Windows® 95 & MS Office 97, Small Business Edition plus Encarta® 97*
- MMX™ Technology-Enhanced Software**
- Gateway Gold™ Premium Service & Support for Desktop PCs

\$4999 As low as* \$174/mo.

G6-266M

- Intel 266MHz Pentium II Processor with 512K Cache
- 64MB EDO DRAM
- CrystalScan®700 .28dp Monitor (15.9" viewable area)
- STB ViRGE/GX 4MB, 3-D 64-Bit PCI Graphics
- 6.4GB 10ms EIDE Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
- ▶ Iomega® Internal ZIP™ Drive
- Ensoniq Wavetable Sound Card
- Altec™ Lansing ACS-410 & ACS-251 Speakers
- TelePath Fax Modem for Windows, x2 Technology Upgradeable*
- Mid-Tower Case
- 104* Keyboard & MS IntelliMouse
- MS Windows 95 & MS Office 97, Small Business Edition plus Encarta 97*
- MMX Technology-Enhanced Software**
- Gateway Gold Service & Support for Desktop PCs

\$3349 As low as* \$116/mo.

G6-233M

- Intel 233MHz Pentium II Processor with 512K Cache
- 32MB EDO DRAM
- CrystalScan700 .28dp Monitor (15.9" viewable area)
- STB ViRGE/GX 4MB, 3-D 64-Bit PCI Graphics
- 3.2GB 12ms EIDE Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
- Ensoniq Wavetable Sound Card
- Altec Lansing ACS-41 Speakers
- TelePath Fax Modem for Windows, x2 Technology Upgradeable*
- Mid-Tower Case
- 104* Keyboard & MS IntelliMouse
- MS Windows 95 & MS Office 97, Small Business Edition plus Encarta 97*
- MMX Technology-Enhanced Software**
- Gateway Gold Service & Support for Desktop PCs

\$2649 As low as* \$92/mo.

Gateway G-Series Professional Systems

G6-266

- Intel 266MHz Pentium II Processor with 512K Cache
- 64MB EDO DRAM
- CrystalScan700 .28dp Monitor (15.9" viewable area)
- STB ViRGE/GX 4MB, 3-D 64-Bit PCI Graphics
- 6.4GB 10ms EIDE Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
- Mid-Tower Case
- 104* Keyboard & MS IntelliMouse
- MS Windows 95 & MS Office 97, Small Business Edition plus Encarta 97*
- Gateway Gold Service & Support for Desktop PCs

\$2999 Business Lease* \$110/mo.

G6-233

- Intel 233MHz Pentium II Processor with 512K Cache
- 32MB EDO DRAM
- CrystalScan700 .28dp Monitor (15.9" viewable area)
- 2MB 3-D 64-Bit PCI Graphics
- 3.2GB 12ms EIDE Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
- Mid-Tower Case
- 104* Keyboard & MS IntelliMouse
- MS Windows 95 & MS Office 97, Small Business Edition plus Encarta 97*
- Gateway Gold Service & Support for Desktop PCs

\$2499 Business Lease* \$92/mo.

Destination™ Big Screen PC/TVs

D6-266

- Intel 266MHz Pentium II Processor with 512K Cache
- 64MB EDO DRAM
- Destination 31" VGA Monitor
- STB 2MB VRAM Graphics Accelerator w/ Cable-Ready TV Tuner
- 6.4GB 10ms EIDE Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
- ▶ EasyPhoto Drive™ Photo Scanner
- Ensoniq Wavetable Sound Card
- ▶ harman/kardon® High-Fidelity Sound System
- TelePath Fax Modem for Windows, x2 Technology Upgradeable*
- 7-Bay Charcoal-Colored PC Case
- Wireless Keyboard w/ Integrated EZ Pad™ Pointing Device
- Wireless Field Mouse® Remote
- MS Windows 95
- Destination Software Collection
- MMX Technology-Enhanced Software**
- Gateway Gold Premium Service & Support for Big Screen PC/TVs

\$4499 As low as* \$156/mo.

D6-233

- Intel 233MHz Pentium II Processor with 512K Cache
- 32MB EDO DRAM
- Destination 31" VGA Monitor
- STB 2MB VRAM Graphics Accelerator w/ Cable-Ready TV Tuner
- 6.4GB 10ms EIDE Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
- Ensoniq Wavetable Sound Card
- ▶ harman/kardon High-Fidelity Sound System
- TelePath Fax Modem for Windows, x2 Technology Upgradeable*
- 7-Bay Charcoal-Colored PC Case
- Wireless Keyboard w/ Integrated EZ Pad Pointing Device
- Wireless Field Mouse Remote
- MS Windows 95
- Destination Software Collection
- MMX Technology-Enhanced Software**
- Gateway Gold Service & Support for Big Screen PC/TVs

\$3999 As low as* \$139/mo.

GATEWAY2000
EASYPAY
LOW MONTHLY PAYMENTS

*Call for details on x2 Technology upgrades.

*MS Office 97, Small Business Edition plus Encarta 97 includes MS Word 97, Excel 97, Publisher 97, Automap® Streets, Small Business Financial Manager and Outlook™ 97.

**MMX Technology-Enhanced Software Bundle includes POD™, Eraser™ - Turn About, The Ultimate Human Body Version 2.0, and The Third Dimension™.

*Financing available on approved credit issued and administered by MBNA America® Bank, N.A. Payments based on 36-month term at 14.9% Annual Percentage Rate.

The Destination 31" monitor is covered by a one-year limited warranty. Call or write for a free copy.

*Leasing arranged by independent leasing companies to qualified commercial customers. Lease payments based on 36-month term. Lease terms subject to change without notice or obligation.



GSA Schedule #GS-35F-4565G

GATEWAY2000
"You've got a friend in the business."®

800-846-7063

www.gw2k.com

GUTSY

COMPANY

[Blazing New Trails]

At Gateway 2000, we do things differently. Who else would headquarter a computer company in South Dakota? And even though we've grown beyond our Midwestern borders, our prairie heritage is still reflected in our pioneering spirit and dedication to technology and value.

Technology Pioneers

When we first stampeded onto the computer scene with a national ad starring cows, the phones went crazy and the competition started losing sleep. Gateway's unique blend of technology, quality, service and price were unmatched in the PC industry then, and we've been raising the bar on industry standards ever since. We're committed to bringing you cutting-edge technology. As Intel's new processors have been released (386, 486, Pentium®, Pentium® Pro, Pentium® with MMX™ technology), Gateway has forged the way, letting you get your hands on the gutsiest technology out there. Now we're doing it again with Pentium® II processors. You don't have to settle for yesterday's technology or wait to be let in on the "secret." Plus we have the guts to stand behind this technology with a three-year limited warranty on desktop PCs and award-winning service and support 24 hours a day, seven days a week for the life of your system.

No Compromises

Count on Gateway 2000 for the inside track on technology. Pentium II processors, MMX technology, huge hard drives, x2™ technology upgrades — it's all here! The wait is over. Order your dream machine today.

**NO
GUTS
NO
GLORY!**

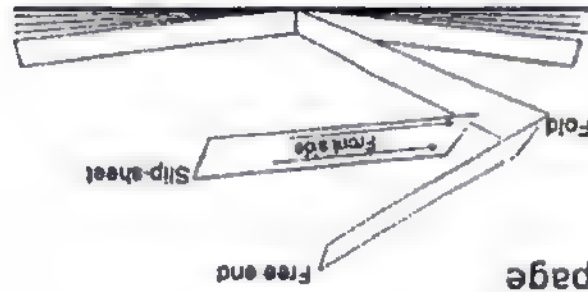
 GATEWAY2000



 **GATEWAY2000**
*You've got a friend in me.

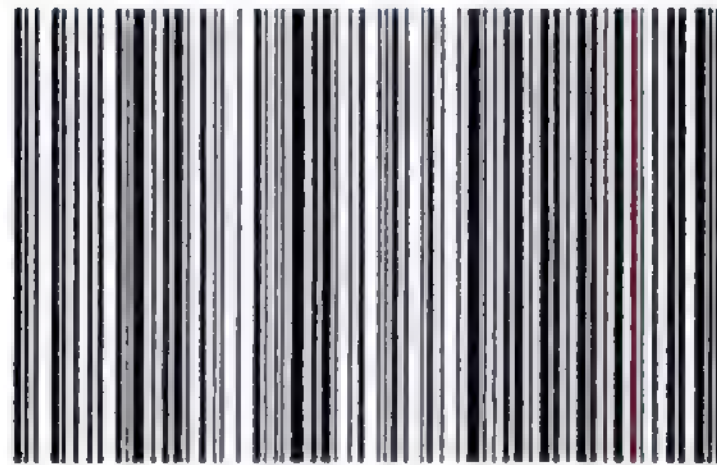
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3. Slice the folded edge
4. Close the page and slip-sheet

Inverted Foldout slip-sheet

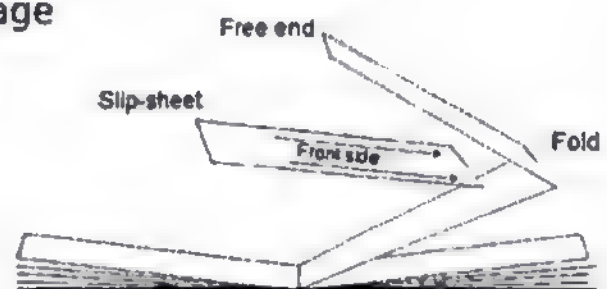


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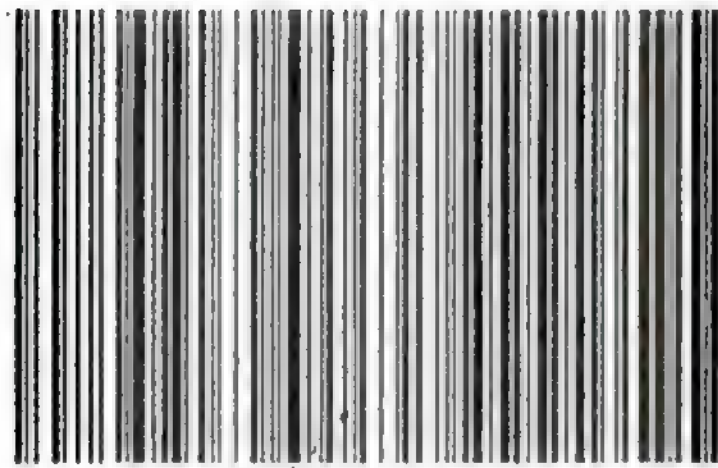
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
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GbsSlipBack-0018

Back

1. Follow instructions on the other side



Volume II • Number 6

n!



WAY 2000 G6-233 Pentium II Processor PC.



Cowabunga!

www.gw2k.com

The Web — A great way to buy



We're pumped!
Coach Waitt, says we're
gonna rock 'n roll in '97!

Gateway upped the ante
in 1996, installing top-selling
software on all new systems!
Now it's Generations III or
MS® Office 97, SBE plus Encarta® 97.

97 Year of
the cow!

OTHER *GUTSY* SYSTEMS

[Expect more from Gateway and get it!]

Gateway G-Series Multimedia Systems

G5-200M

- Intel® 200MHz Pentium® Processor with MMX™ Technology
- 32MB Synchronous DRAM
- 512K Pipelined Burst Cache
- CrystalScan™700 .28dp Monitor (15.9" viewable area)
- 2MB 3-D 64-Bit PCI Graphics
- 3.2GB 12ms EIDE Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
- Ensoniq® Wavetable Sound Card
- Altec™ Lansing ACS-41 Speakers
- TelePath® Fax Modem for Windows, x2™ Technology Upgradeable*
- Mid-Tower Case
- 104* Keyboard & MS® IntelliMouse™
- Microsoft® Windows® 95 & MS Office 97, Small Business Edition plus Encarta® 97*
- MMX Technology-Enhanced Software**
- Gateway Gold™ Service & Support for Desktop PCs

\$2399 As low as* \$84/mo.

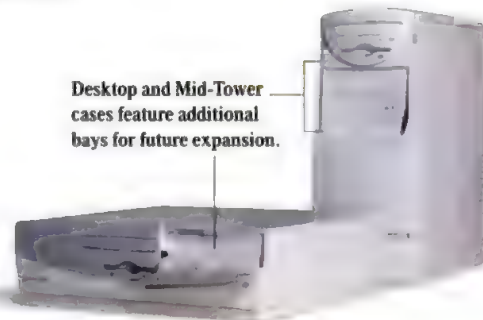
G5-166M

- Intel 166MHz Pentium® Processor with MMX Technology
- 16MB Synchronous DRAM
- 256K Pipelined Burst Cache
- CrystalScan500 .28dp Monitor (13.9" viewable area)
- 2MB 3-D 64-Bit PCI Graphics
- 1.6GB 12ms EIDE Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
- 16-Bit GATEWAY™ Sound
- Altec Lansing ACS-41 Speakers
- TelePath Fax Modem for Windows, x2 Technology Upgradeable*
- Mid-Tower Case
- 104* Keyboard & MS IntelliMouse
- MS Windows 95 & MS Office 97, Small Business Edition plus Encarta 97*
- MMX Technology-Enhanced Software**
- Gateway Gold Service & Support for Desktop PCs

\$1799 As low as* \$63/mo.

Please call for other configurations.
We custom build each **GATEWAY 2000®** system to your specifications.

Desktop and Mid-Tower cases feature additional bays for future expansion.



Gateway G-Series Professional Systems

G6-200²

- ▶ Intel 200MHz Pentium® Pro (Dual-Processor Ready)
- 64MB EDO ECC Memory
- 256K Internal Cache
- CrystalScan700 .28dp Monitor (15.9" viewable area)
- 4MB 3-D 64-Bit PCI Graphics
- 4GB 8ms SCSI Hard Drive
- 12X SCSI CD-ROM & 3.5" Diskette Drives
- ▶ APC® 650 Pro UPS®
- Tower Case
- 104* Keyboard & MS IntelliMouse
- ▶ MS Windows NT® 4.0 & MS Office 97, Small Business Edition plus Encarta 97*
- Gateway Gold Service & Support for Desktop PCs

\$3849 Business Lease¹ \$141/mo.

G5-200

- Intel 200MHz Pentium® Processor
- 32MB Synchronous DRAM
- 256K Pipelined Burst Cache
- CrystalScan700 .28dp Monitor (15.9" viewable area)
- 2MB 3-D 64-Bit PCI Graphics
- 3.2GB 12ms EIDE Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
- Mid-Tower Case
- 104* Keyboard & MS IntelliMouse
- MS Windows 95 & MS Office 97, Small Business Edition plus Encarta 97*
- Gateway Gold Service & Support for Desktop PCs

\$1999 Business Lease¹ \$74/mo.

G5-166

- Intel 166MHz Pentium Processor
- 16MB Synchronous DRAM
- 256K Pipelined Burst Cache
- CrystalScan500 .28dp Monitor (13.9" viewable area)
- 2MB 3-D 64-Bit PCI Graphics
- 1.6GB 12ms EIDE Hard Drive
- 12X min/16X max CD-ROM & 3.5" Diskette Drives
- Desktop Case
- 104* Keyboard & MS IntelliMouse
- MS Windows 95 & MS Office 97, Small Business Edition plus Encarta 97*
- Gateway Gold Service & Support for Desktop PCs

\$1599 Business Lease¹ \$59/mo.

Gateway Solo™ Portable PCs

2200 S5-166XL

- 12.1" SVGA Active Matrix Color Display
- Intel 166MHz Pentium Processor with MMX Technology
- 48MB EDO DRAM expandable to 80MB
- 256K Pipelined Burst Cache
- 2MB EDO Video RAM
- Zoomed Video Port
- NTSC/PAL Video Output
- 2GB Hard Drive
- Modular 6X min/11X max CD-ROM Drive
- Modular 3.5" Diskette Drive
- 16-Bit Wavetable Sound and Stereo Speakers
- 33.6 PCMCIA Data**/14.4 Fax Modem
- 2 Lithium Ion Batteries & AC Pack
- 85-Key MS Windows 95 Keyboard
- Carrying Case
- MS Windows 95 & MS Office 97, Small Business Edition plus Encarta 97*
- Gateway Gold Service & Support for Portable PCs

\$4399 As low as* \$153/mo.

2200 S5-166

- 12.1" SVGA Active Matrix Color Display
- Intel 166MHz Pentium Processor with MMX Technology
- 32MB EDO DRAM expandable to 80MB
- 256K Pipelined Burst Cache
- 2MB EDO Video RAM
- Zoomed Video Port
- NTSC/PAL Video Output
- 2GB Hard Drive
- Modular 6X min/11X max CD-ROM Drive
- Modular 3.5" Diskette Drive
- 16-Bit Wavetable Sound and Stereo Speakers
- Lithium Ion Battery & AC Pack
- 85-Key MS Windows 95 Keyboard
- Carrying Case
- MS Windows 95 & MS Office 97, Small Business Edition plus Encarta 97*
- Gateway Gold Service & Support for Portable PCs

\$3849 As low as* \$134/mo.

2200 S5-120

- 12.1" SVGA Active Matrix Color Display
- Intel 120MHz Pentium Processor
- 24MB EDO DRAM expandable to 80MB
- 256K Pipelined Burst Cache
- 1MB EDO Video RAM
- Zoomed Video Port
- 1GB Hard Drive
- Modular 6X min/11X max CD-ROM Drive
- Modular 3.5" Diskette Drive
- 16-Bit Sound & Stereo Speakers
- NiMH Battery & AC Pack
- 85-Key MS Windows 95 Keyboard
- Carrying Case
- MS Windows 95
- MS Works 95
- Gateway Gold Service & Support for Portable PCs

\$2729 As low as* \$95/mo.

2100 S5-120

- 11.3" SVGA DSTN Color Display
- Intel 120MHz Pentium Processor
- 16MB EDO DRAM expandable to 72MB
- 256K Pipelined Burst Cache
- 1MB EDO Video RAM
- Zoomed Video Port
- 1GB Hard Drive
- Modular 6X min/11X max CD-ROM Drive
- Modular 3.5" Diskette Drive
- 16-Bit Sound & Stereo Speakers
- NiMH Battery & AC Pack
- 85-Key MS Windows 95 Keyboard
- Carrying Case
- MS Windows 95
- MS Works 95
- Gateway Gold Service & Support for Portable PCs

\$1999 As low as* \$70/mo.

*Maximum data transfer rate dependent on certain variables including particular modems with which you are communicating, telephone lines, communications software and communications protocols.

GUTSY UPGRADES (Sold only with the purchase of a system.)

Desktop Upgrades

- Altec™ Lansing ACS-251 Subwoofer \$75
- Altec Lansing ACS-410 Dolby® Surround Sound Speaker System w/ ACS-251 Subwoofer \$120
(upgrade from PCs that include Altec ACS-41 speakers)
- Iomega® Ditto™ 3200 Internal Tape Backup Unit \$199
3200MB with compression, nominal 1600MB
- Iomega Internal ZIP™ 100MB Drive \$139
(includes three 100MB cartridges)
- Iomega External ZIP 100MB Drive \$159
- Iomega Jaz® 1GB Drive \$429
(includes SCSI controller and 1GB cartridge)
- MS® Windows NT® 4.0 Upgrade \$99
(upgrade from PCs that include MS Windows® 95)

Portable PC Upgrades

- Gateway Solo™ Mini Docking Station \$199
- 33.6 Data™/14.4 Fax Modem \$200
- Gateway Solo 2100 upgrade from an 11.3" Dual Scan to a 12.1" SVGA Active Matrix display \$530

**Maximum data transfer rate dependent on certain variables including particular modems with which you are communicating, telephone lines, communications software and communications protocols



**On-site service is available to most locations in the continental United States, Alaska, Hawaii, Puerto Rico and Canada after you and your Gateway technician determine an on-site visit is necessary. On-site service is provided by PC Technology Services, Inc. On-site is not available for any monitor, mouse, keyboard, or portable system. Write or call for a free copy of the on-site service agreement

Destination™ Big Screen PC/TV Upgrades

- harman/kardon® High-Fidelity Sound System
Seven-piece Dolby Pro Logic® Surround Sound speaker system including AVR-10 audio/video receiver with remote, subwoofer, center channel, and four satellites for the ultimate multimedia audio experience. \$599
- EasyPhoto Drive™ Photo Scanner Upgrade \$149
- Additional Destination 31-Inch VGA Color Monitor \$999
(Call for details.)

Service & Support for Desktop Systems

GATEWAY GOLD™ PREMIUM

Extended Three-Year On-Site Agreement^{††} including priority 800 number for access to technical experts.

- At time of system purchase \$99
- Within current on-site service agreement \$129

For our complete line of software and peripherals call GATEWAY™ component add-on sales at 800-846-2080.

Sales Hours: 7am-10pm Weekdays (CT).

GUTSY EXTRAS (Available to existing customers and new Gateway customers with system purchase.)

GATEWAY SELECT

Our Gateway Select program lets you know you're getting software that meets or exceeds our standards for quality, value and ease of use.

Software

- Games & Entertainment Pack II Includes Bug!™; Deadlock™; MechWarrior® 2: Mercenaries™; 9™; Pitfall: The Mayan Adventure®; SPQR: The Empire's Darkest Hour™; and PC ProPad gaming device. \$99
- Finance Pack II (U.S. Shipment Only) Includes Quicken® Deluxe 6, Quicken Financial Planner™ 2, Quicken Family Lawyer™ 7, and Quicken Parents' Guide to Money™ \$69
- Kid's BackPack™ IV
Includes Math Blaster®: In Search Of Spot, Freddi Fish™ And The Case Of The Missing Kelp Seeds™; Pajama Sam™ In "No Need To Hide When It's Dark Outside,"™ and Muppet Treasure Island™. \$59

Extras

- MS SideWinder™ 3D Pro Joystick \$59
- APC® Back-UPS® Office \$149
- APC 650 Pro UPS \$329
- Epson® PhotoPlus™ Color Photo Scanner \$199
- Visioneer™ PaperPort Vx™ Scanner \$249

Printers

(Each printer includes cable and ink cartridge.)

- Epson Stylus® Color 400 Ink Jet Printer \$229
- Epson Stylus Color 600 Ink Jet Printer \$299
- Hewlett-Packard DeskJet 694C Color Printer \$299
- Hewlett-Packard DeskJet 820Cse Color Printer \$399
- Hewlett-Packard LaserJet 5L Xtra Laser Printer \$399
- Hewlett-Packard LaserJet 6P Laser Printer \$749



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FaxBack 800-846-4526 • International FaxBack Access 605-232-2561 • Component Add-On Sales 800-846-2080 • Sales Hours: 7am-10pm Weekdays, 8am-8pm Saturdays & Sundays (CT)

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* All x2 products are capable of 56 Kbps downloads; however, due to FCC rules which restrict power output of service providers' modems, current download speeds are limited to 53 Kbps. Actual speeds may vary depending on line conditions. Uploads from end users to providers travel at speeds up to 28.8 Kbps.

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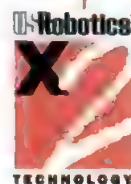
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First Looks



PowerMax A53 200MMX

Street price: With AMD-K6/PR200, 32MB SDRAM, 512K L2 cache, 3.2GB hard disk, max16 CD-ROM, 17-inch monitor, \$2,049

CyberMax Computer, Allentown, PA; 800-443-8688, 610-776-1888
www.cybmax.com

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Unlike Dell and Gateway, Quantex has opted for Intel's latest Pentium chip set, the 430TX. The QP5/233's Baby AT motherboard—an Intel model as well—also carries 32MB of EDO DRAM and 512K of L2 cache. The board's only weakness is a lack of USB.

With an STB Nitro graphics accelerator card (4MB of EDO DRAM) and a 4GB Western Digital IDE hard disk, this system produced lukewarm test scores. On our Winstone and Graphics WinMark tests, its results barely cracked the average range; and on our Disk WinMark test, the Quantex machine posted a below-average result.

The unit's CD-ROM WinMark score was well below this roundup's average, but considering that DVD drives play CDs at 8X speeds, this score is not surprising. The Toshiba DVD drive allows you to play compressed video with more clarity than you'll see on a television screen. Quantex will ship

several DVD movies with the QP5/233, but it has not decided on titles yet.

The system also ships with an Ensoniq wavetable sound card, a Computer Peripherals 33.6-Kbps modem, a 17-inch Mag InnoVision monitor, a Cinemaster video capture card, a pair of massive Altec Lansing speakers, and a subwoofer. The version we tested also came with a TV tuner card, but Quantex has decided to discontinue this option. It will, however, include a digital camera with shipping models.

If you are intrigued by DVD and want to get your feet wet in this new medium at an affordable price, then check out the QP5/233.

CyberMax Computer PowerMax A53 200MMX

The PowerMax A53 200MMX proves that the low price of the K6 processor can translate directly into a low-priced yet adept PC. This machine delivers the same level of Windows 95 performance that you'd get from a 233-MHz MMX Pentium, and it sells for only \$2,049. The PowerMax 200-MHz system is ideal for the cost-conscious yet demanding SOHO user.

Despite its price, the PowerMax is fully equipped. It ships with a 17-inch Mag InnoVision monitor, twin Altec Lansing speakers, a matching subwoofer, and a Computer Peripherals 33.6-Kbps modem. Its Baby-AT motherboard from M Technology supports a 200-MHz K6 processor with the SiS 5571 chip set, 32MB of SDRAM, and 512K of L2 cache.

Under Windows 95, the PowerMax was nothing short of a great performer. Equipped with a Matrox Millennium graphics card and 4MB of WRAM, the machine was the third-leading Graphics WinMark and Winstone performer. A Toshiba max16 CD-ROM

delivered the second-highest CD-ROM WinMark score in our roundup, while a 5,400-rpm IBM 3.2GB ATA-3 hard disk contributed to an average Disk WinMark result.

During MMX testing, results fell into the midrange. Though we had to install drivers for its Ensoniq AudioPCI card ourselves, the system exhibited exemplary sound during our anecdotal audio testing. A good subwoofer (like the included Altec Lansing speakers have) is a must for multimedia SOHO systems.

The PowerMax chassis cover comes off easily after the removal of three rear screws, providing access to three unused 5.25-inch bays and a pair of unused 3.5-inch bays. With the modem occupying an ISA slot, the graphics card plugged into the one shared slot and the sound card used a PCI slot; there are two available PCI and two ISA expansion options.

Perhaps the PowerMax's only weakness is its lack of USB support, but it does offer two DIMM sockets and four SIMM sockets for up to 384MB RAM. The PowerMax is the bargain of this group. Surprisingly, it achieves such status without sacrificing a thing.

Nova Computers Inc.

Nova PK6-2002

Ohio-based Nova Computers' \$2,649 Nova PK6-2002 show how important it is to equip your PC with not only adept hardware, but the proper drivers as well. This machine arrived at PC Labs with a less-than-optimal graphics driver installed, and its performance suffered dramatically. There is, however, a silver lining: ample expandability and an attractive software bundle.

The Nova PK6 couples its 200-MHz K6 processor with Intel's 430TX core-logic chip set. The Baby-AT motherboard is also equipped with 32MB of SDRAM and 512K of L2 cache.

Despite this healthy core of components, the Nova was an abysmal benchmark-test performer. Instead of loading a driver specific to its Diamond Stealth 3D 2000 graphics card (4MB EDO DRAM), Nova loaded a generic S3 driver. Consequently, its Graphics WinMark and Winstone scores were disproportionately poor. Even with the correct driver loaded, however, its test scores were still the lowest of the roundup.

Due to a 4,500-rpm Quantum Fireball hard disk, the Nova's Disk WinMark score was also well below average. Only its Toshiba 12X CD-ROM drive turned in respectable numbers.

With a graphics card, a Creative Labs Sound Blaster AWE64 audio card, and a U.S. Robotics 33.6-Kbps Sportster modem in place, the Nova has two available PCI and two available ISA slots. Though the motherboard itself is rather crowded, the system has ample



Nova PK6-2002

Direct price: With AMD-K6/PR200, 32MB SDRAM, 512K L2 cache, 3.8GB hard disk, 12X CD-ROM drive, 17-inch monitor, \$2,649

Nova Computers Inc., Wickliffe, OH; 800-461-5535, 216-516-3030; fax, 216-516-3040

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First Looks

room for the addition of new drives. Three front-accessible 5.25-inch bays and a pair of standard internal 3.5-inch bays are open for expansion. Each of these bays slide in and out of the chassis for easy insertion and removal of fixed devices. Should you wish to add yet another drive, the system's plastic top retracts to reveal a third 3.5-inch bay.

The Nova lacks USB ports but offers a tool-free chassis, a 17-inch Mag InnoVision monitor, an ergonomic keyboard with integrated touch pad (an ordinary mouse is supplied as well), two Roland speakers, and a standup microphone.

With the proper drivers installed, the Nova PK6-2002 is an adequate machine, but if you want a 200-MHz K6 PC, the CyberMax is a better deal.

Polywell Computer Inc.

Poly K6233Mx

Like the CyberMax PowerMax, the \$2,490 Polywell Poly K6233Mx is an extraordinary bargain. Priced less than most systems here, it nonetheless delivered great numbers on our benchmark tests. The system came to us without external speakers, but otherwise it was well-equipped.

The Poly is a slate-gray, contoured midtower. Its Fretek motherboard houses a 233-MHz K6 processor and 512K of L2 cache. And like Nova Computers, Polywell has not eschewed Intel hardware with the 430TX chip set. The board also offers two USB ports, 32MB of SDRAM (128MB maximum on two DIMMs or four SIMMs), a trio of open PCI slots, and one available ISA slot.

Processor aside, the machine's primary strength is its hard disk: A 5.1GB Maxtor. This 5,400-rpm device was essential to the Poly's benchmark proficiency. Running Winstone and Disk WinMark under Windows 95, the Poly trailed only the Tiger machine—a \$4,278



Poly K6233Mx

Street price: With AMD-K6/PR233, 32MB SDRAM, 512K L2 cache, 5.1GB hard disk, 12X CD-ROM drive, 17-inch monitor, \$2,490

Polywell Computer Inc., South San Francisco, CA; 800-959-1276, 415-563-7222; fax, 415-563-1974

www.polywell.com

Circle 422 on reader service card.

system with a 10,000-rpm hard disk. During CPUmark₃₂ testing, the Poly delivered this roundup's highest score.

The system's MMX scores were highly competitive: It was the best performer of the K6s (not including the TigerDirect), but it was outperformed by both NEC and Gateway on the Pentium side of the fence. Using a Diamond Stealth 3D 2000 graphics board with 4MB of EDO DRAM and a Matsushita 12X CD-ROM drive, the Poly's Graphics and CD-ROM WinMark scores were average.

Polywell also ships the system with a Crystal Semiconductor Crystalwave 32AW-3D sound card, a GVC 33.6-Kbps modem, a microphone, and a Sampo 17-inch monitor. Though not shipped with our test machine, a pair of Quickshot Sound Force 300 speakers are included in the above price.

There was, however, a slight problem with the construction of the Poly PC we tested. Because its motherboard was missing a screw (which is needed to fasten it to the chassis), its keyboard connector would frequently dislodge due to abnormal movement from the loose motherboard.

Finally, the company ships this spacious, well-organized machine with Microsoft's Encarta 95 and Works as well as several edutainment titles.

TigerDirect Inc.

TigerDirect K6/233

Though the TigerDirect K6/233 was this roundup's leading performer, it is not necessarily the best option. The performance of this 233-MHz K6 system is largely a product of its 10,000-rpm Ultra SCSI hard disk, a component that contributes heavily to its \$4,278 price. In fact, the Dell Dimension offers comparable performance and a much bigger hard disk for \$1,000 less.

Yet TigerDirect—a small Miami-based company that sells custom-made PCs in the vein of Dell and Gateway—also offers a \$1,999 version of the K6/233 with a 4.3GB EIDE hard disk and a cheaper graphics card.

If you're willing to spend the money, however, the machine tested by PC Labs is a very fast Windows 95 PC. Outfitted with 32MB of EDO DRAM and 512K of L2 cache, its Business Winstone score led the pack.

Thanks to a 4.3GB Seagate Cheetah hard disk and a Matrox Millennium graphics card, the system also bettered each machine reviewed here on our Graphics WinMark and Disk WinMark tests by a small margin. Using a Sanyo 20X CD-ROM drive, it was an average CD-ROM WinMark performer, but its MMX numbers were unmatched.

The TigerDirect K6/233 uses

an FIC motherboard with two USB ports and a VIA chipset based on AMD technology designed specifically for the K6. The tested system ships with a Creative Labs Sound Blaster AWE64 audio card, a U.S. Robotics 56-Kbps modem, a 17-inch Sony monitor, a Microsoft ergonomic keyboard, and a pair of Yamaha speakers.

Since it ships with a SCSI controller and modem as well as a graphics card and sound board, the machine has relatively few slots open for expansion: one PCI, one ISA, and one shared. Yet there are myriad drive bays: five 3.5-inch (one external and four internal) and one 5.25-inch. Even though they are hard to get to, two DIMM slots and four SIMM slots are also offered.

If you've got to have a fast hard disk, the Tiger PC may be worth a look. Still, a \$1,000 premium is a lot of money to spend for a few more points scored on a benchmark test. □



TigerDirect K6/233

Direct price: With AMD-K6/PR233, 32MB EDO DRAM, 512K L2 cache, 4.3GB Ultra SCSI hard disk, 20X CD-ROM drive, 17-inch monitor, \$4,278

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First Looks

GRAPHICS ACCELERATORS

Graphics for the Masses

Matrox's Millennium II and Diamond's Fire GL 1000 offer different graphics solutions.—By Rob Glidden

Entry-level professional graphics is the general target audience for both the Millennium II from Matrox Graphics and the Fire GL 1000 from Diamond Multimedia. "Entry level" in this context means that these boards cost more than typical graphics boards, but less than "true" professional video and 3-D graphics boards (which cost hundreds or thousands more). Specifically, the Millennium II is geared toward general-purpose, high-resolution 2-D uses with an emphasis on desktop graphics and video. The Fire GL is a 3-D-oriented board that's aimed primarily at the entry-level 3-D modeling and animation and CAD markets.

DIAMOND FIRE GL 1000

The Fire GL 1000 from Diamond Multimedia is a 3D-oriented graphics board based on the 3DLabs Permedia NT chip set. Intended foremost as an OpenGL board for Windows NT, the Fire GL 1000 also runs perfectly well under Windows 95.

The Fire GL 1000 hits the mark as an entry-level board for 3-D modeling and animation, CAD, and OpenGL-based applications. With drivers included for Direct3D, OpenGL, and Heidi (AutoCAD and 3D Studio), most 3-D bases are covered.

The Fire GL 1000's test scores back up this 3-D emphasis: On our 3D WinBench 97 test, the Fire GL's score exceeded the Millennium II's by 40 percent. On 2-D, however (as measured by our Winstone and Graphics WinMark tests), its scores fell behind those of the Millennium.

The emphasis on 3-D does carry a price for 2-D performance at higher screen resolu-

tions. Because the Fire GL 1000 uses double buffering (banking the graphics memory into separate modules to speed 3-D rendering), resolution is limited. On the 8MB Fire GL 1000, 1,152-by-870 is the highest screen resolution you can reach with 24-bit color, even though the Fire GL has a high-speed 220-MHz DAC (digital-to-analog converter). This is below the resolution you would expect from a 2-D board

with this amount of memory.

The Fire GL is bundled with Macromedia's Extreme 3D 2 modeling and animation tool, IDS's V Realm Builder 1.1 VRML authoring tool, as well as Diamond's 3D Win AutoCAD viewer and Big Focus display-list driver technology for AutoCAD Release 13.

If you are looking for a relatively inexpensive board for professional 3-D graphics with OpenGL, then you should consider the Fire GL.

Diamond Fire GL 1000. Street price: \$300 for 4MB version, \$400 for 8MB version. Diamond Multimedia Systems, San Jose, CA,

95134; 800-468-5846, 408-325-7000; www.diamondmm.com. Circle 413 on reader service card.

MATROX MILLENNIUM II

Matrox's new Millennium II, powered by the vendor's MGA-2164W chip, is essentially an upgraded version of the lower-end Matrox Mystique but adds WRAM. The Millennium includes a set of 2-D and 3-D features, including WRAM expandability to 16MB, standard 3-D Gouraud shading and textured rendering, 16- or 32-bit Z-buffering, and full-motion video support. The MGA PowerDesk settings dialogs allow you to set color temperature and gamma.

On our Winstone and Graphics WinMark tests, the Millennium II outperformed the Fire GL on nearly every measure. Under Windows NT, its High-End Graphics WinMark score beat the Diamond board by 21 percent. Under Windows 95, the Millennium II bested the Fire GL by 5 to 13 percent on our business-oriented benchmarks and 13 to 82 percent on our high-end measures.

With a maximum screen resolution of 1,920-by-1,080, the Millennium should handle even the most demanding high-resolution needs. The Millennium II will come in two versions, one with a 250-MHz DAC (tested here) and one with a 220-MHz DAC. Unless you need very high screen resolutions, you will find the 220-MHz DAC more than adequate.

The speed of the DAC determines the maximum refresh rate possible at a given screen resolution. For example, with the Mil-

lennium II 250-MHz DAC, the maximum refresh rate is 80 Hz for a 1,920-by-1,080 screen versus 75 Hz with the 220-MHz DAC. Still, few monitors can actually handle this high a resolution.

If you are interested in video editing, Matrox offers the \$249



Rainbow Runner series of video add-on boards that you can plug into the Millennium II (as well as the Matrox Mystique). The Rainbow Runner turns the Millennium II into a serviceable video-editing tool for video enthusiasts and Web or multimedia authors, with motion-JPEG video editing, hardware MPEG, live-video capture, video out, and TV tuning.

The Millennium II includes a bundle of software that alone makes it a good value. Included are Micrografx's Simply 3D 2, Picture Publisher 7, and Kai's Power Tools. Rounding out the software bundle are CompCores' SoftPEG software MPEG decoder, Netscape Navigator 3.0, Vream's WIRL VRML browser, and the Sonnetech Colorific color management utility.

Matrox Millennium II. Street price: \$350 with 250-MHz DAC and 4MB of WRAM; \$410 for 8MB of WRAM. Matrox Graphics Inc., Dorval, Quebec, Canada; 800-844-8302, 514-969-6300; www.matrox.com. Circle 414 on reader service card.

BENCHMARK TESTS



Graphics Accelerators

WINDOWS 95

1,024-by-768, 16-bit color

Higher scores represent better performance.	ZD Business Graphics WinMark 97	ZD Business Winstone 97	ZD 3D WinBench
Diamond Fire GL 1000	37	58	16
Matrox Millennium II	68	39	41

WINDOWS NT

1,024-by-768, 24-bit color

ZD High-End Graphics WinMark 97	ZD High-End Winstone 97
Diamond Fire GL 1000	15
Matrox Millennium II	23

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First Looks

DIGITAL CAMERAS

Forget the Film

Four new models advance the state of the art.—By Daniel Grotta and Sally Weiner Grotta

With almost 100 digital cameras on the market, it's not surprising that every manufacturer tries to tailor its product in some special way to make it stand out in the crowd. These four entry-level digital cameras each offer a unique feature that will help earn them fans.

All of the \$700 Canon PowerShot 350's buttons and controls are exceptionally user-friendly. The \$700 Casio QV-300 has a 2.5-inch LCD and a switchable wide angle/telephoto lens. The \$500 Epson PhotoPC 500 has better optics and more memory than its best-selling predecessor, the PhotoPC. And the \$490 Nikon CoolPix 100 is the first digital camera built onto a PC card.

All incorporate fixed focus lenses, electronic shutters, and an ISO equivalency of 100 to 130. Also, they all can save or acquire images in JPEG format and work out of the box on both the PC and Mac. All are powered by AA batteries, although the Canon is the only one with rechargeable nicads and a transformer. Three of the four cameras yield 640-by-480 resolution (the CoolPix 100 yields 512-by-480), and all but the Casio have 1/3-inch charge-coupled devices with square pixels (square is better). Except for the Casio, all have built-in electronic strobe lights with auto-fill and red-eye reduction.

If speed, convenience, and compact size are all paramount, the CoolPix 100 is the clear winner. For greatest versatility and the best display, the QV-300 is tops. For the most control, sophistication, and sheer fun, the PowerShot 350

stands out. But if image quality matters most, our nod is to the PhotoPC 500.

CANON POWERSHOT 350

The PowerShot 350, the best overall price-performer in this group, is a small, compact, square-shaped device with an ergonomically styled pistol grip and a swing-out LCD viewer for easy composing and shooting. Unlike the continuously refreshed LCD

manually by adjusting a lever on the side of the camera.

Exposure compensation is a breeze to set. You push the small +/- button and then the large +/- button to increase or decrease overall brightness or darkness in one-stop increments. The built-in automatic white balance does a credible job maintaining color balance under most conditions.

Other controls let you switch between record and play; delete all images or the last image shot; change the time and date; display 1, 4, or 16 images simultaneously on the LCD or a TV set (via the video-out port); display either the number of shots taken or the number of shots left; select

and it was a snap to pop the CompactFlash card into an adapter and then into a drive to download images.

Canon PowerShot 350. Street price: \$700. Requires: 8MB RAM, 486 PC or better, Microsoft Windows 95. Canon Computer Systems Inc., Costa Mesa, CA; 800-848-4123, 714-438-3000; www.powershot.com. Circle 401 on reader service card.

CASIO QV-300

The Casio QV-300 looks and shoots like other Casio digital cameras, but with one major difference: It's about 50 percent larger and longer. Its ergonomically styled body won't fit into a shirt pocket, but it can accommodate an oversized 2.5-inch color LCD viewer on the back.

Unlike most digital cameras, which have the same resolution but use different levels of compression to change image quality, the QV-300 toggles between 640-by-480 and 320-by-240 resolutions. The fixed focus swivel lens may be manually switched between telephoto and wide angle as well as normal view and macro. Its adjustable LCD viewer is refreshed about four times a second. Although the large viewfinder is easy to see, the tradeoff is power consumption: A set of AA alkalines will last less than an hour; an AC adapter is a \$19.95 option.

Shooting images is almost as simple as operating a box camera. After turning the camera on, select the mode button to record, point at your subject, and press the shutter. Because the QV-300 has neither a flash nor an automatic light sensor, you must manually set the aperture if the LCD appears too dark or too bright. If the image in the viewfinder is still too light or dark, push the +/- button on top to compensate for up to six stops.

Our test image was bright and



viewer on the Epson PhotoPC 500, the PowerShot 350's LCD updates a jerky 3 to 4 times a second. Although the hinged LCD on the back has a brightness adjustment wheel, it is still difficult to see in sunlight. The camera could be greatly improved by adding an optical viewfinder.

Like many other digital cameras, the PowerShot 350 has a large number of buttons, levers, and switches—16 in all—but they're all clearly marked, logically clustered, and easy to activate. Although its fixed focus lens has a depth of field of two feet to infinity, the macro mode (1.2 to 26 inches) is engaged and focused

full, fill, or red-eye flash; select fine, normal, or economy modes; and activate the self-timer. There are two status lights to indicate when the camera is busy, ready, or charging.

Taking pictures with the PowerShot 350 is simple, and given its one-handed operation and swing-out LCD, it's also fun. The camera does an excellent job averaging bright and low light for proper exposure. Though our test images were sharp and did not display any noticeable aliasing, the colors of the red jacket and blue car were slightly undersaturated and unrealistic.

Picture quality was excellent,

sharp, and the colors were relatively accurate. Nevertheless, it was the only camera that produced an unacceptable amount of lens flare, probably because the Casio lens is more recessed than those on other cameras. The image also exhibited a significant amount of aliasing.

With both serial and video-out ports, you can easily download to a PC via bundled software. You can also output directly to a TV set or to Casio's snapshot printer (First Looks, April 8, 1997).

Casio QV-300. Street price: \$700. Requires: 8MB RAM, 486 PC or better, Microsoft Windows 3.1 or later, or Windows 95. Casio Inc., Dover, NJ; 800-962-2746, 201-361-5400; www.casio.com. *Circle 402 on reader service card.*

EPSON PHOTOPC 500

The Epson PhotoPC 500 looks and feels more like a conventional 35-mm rangefinder camera than a digital device. Its optical viewfinder has frosted frame marks that make lining up the subject effortless, even in direct sunlight. The LCD control panel is on top and to the left of the shutter and has four controls: fine/standard resolution mode, self-timer, auto/full/red-eye reduction flash mode, and a recessed delete-image button. There are two frame counters, one indicating the number of pictures taken and the other showing the number of frames remaining. The only other control is the on/off switch, placed below and to the left of the lens.

The PhotoPC 500 was the only camera we tested that does not feature a macro mode, but you can screw a variety of third-party auxiliary filters and telephoto, wide angle, or close-up lenses onto its 37-mm thread. Like the Casio QV-300, the PhotoPC toggles between fine and standard mode by changing resolution—640-by-480 and 320-by-240—instead of compression levels. Both the lens aperture and shutter speed are set by the camera automatically,

SUMMARY OF FEATURES

Digital Cameras

■ YES □ NO □ OPTIONAL
In alphabetical order by company

	Canon PowerShot 350	Casio QV-300	Epson PhotoPC 500	Nikon CoolPix 100
Street price	\$700	\$700	\$500	\$490
Image resolution	640 x 480	640 x 480, 320 x 240	640 x 480, 320 x 240	512 x 480
ISO equivalency	120	100	130	100
Lens	f/2.8	f/2.8, f/8 telephoto/wide	f/2.8	f/4
Macro	■	■	□	■
Pixel density	350,000	350,000	330,000	330,000
Shutter speed (seconds)	1/4 to 1/1,000	1/8 to 1/4,000	1/30 to 1/10,000	1/45 to 1/10,000
Memory type	2MB CompactFlash	4MB internal	2MB internal	1MB internal
Image capacity: Fine/Standard/Economy	11, 23, 47	64, 192, N/A	30, 60, N/A	21, 42, N/A
Raw file size: Fine/Standard/Economy	150K, 75K, 37K	75K, 25K, N/A	57K, 27.5K, N/A	48K, 28K, N/A
Flash/Red-eye reduction	■ ■	■ ■	■ ■	■ ■
Automatic white point	■	■	■	■
Exposure compensation	■ (±3 stops)	■ (±3 stops)	■	■
Viewfinder type	1.8-inch color LCD	2.5-inch color LCD	Optical*	Optical
Computer interface	Serial	Serial	Serial	Type II/III PC card
Video out/Digital in	■	■ ■	■	■
Software included	Canon TimeTunnel and Stitch, ULead PhotoImpact SE	Adobe PhotoDeluxe, Ixala Photo	Epson image-editing software, Sierra Print Artist	EasyPhoto
Dimensions (HWD, in inches)	3.5 x 3.8 x 2.0	6.4 x 2.8 x 1.9	5.5 x 3.2 x 2.1	2.4 x 6.1 x 1.4

* Optional 1.8-inch LCD N/A—Not applicable The product does not have this feature

but you can manually change the shutter speed from 1/30th to 1/4000th of a second.

The PhotoPC comes equipped with 2MB of internal RAM and is upgradable to 6MB; there's no provision for removable storage media. An optional 1.8-inch LCD color viewer can snap on the back for direct viewing and focusing or playback.

The main drawback to the PhotoPC 500 is its size: When attached, the camera and viewer are nearly nine inches long. Nevertheless, except for the five- to eight-second delay that all digital cameras have, shooting the PhotoPC 500 is no different than taking pictures with a film-based point-and-shoot camera. Our test images were crisp and well-exposed, the colors were accurate and correctly saturated, and the aliasing was nicely feathered.

Epson PhotoPC 500. Street price: \$500. Requires: 8MB RAM, 486 PC or better, Microsoft Windows 3.1 or later, or Windows 95. Epson America Inc., Torrance, CA; 800-463-7766, 310-782-0770; www.epson.com. *Circle 403 on reader service card.*

NIKON COOLPIX 100

The CoolPix 100 is small and slim and can easily be used one-handed. The camera's frosted frame marks inside the optical viewfinder facilitate easy composing, even when the macro switch on the side is activated. But since there's no LCD or auto-focus, you have to estimate close-up distances. The oval-shaped shutter is situated in the front and center of the camera, and it's designed for half-release (to activate the flash and ensure that everything is in the ready mode) and full depression (to take the shot).

The top of the CoolPix has an LCD control panel and four buttons. One button toggles between fine and standard image quality, another selects the flash mode, a third allows last frame or global deletions, and a fourth activates the self-timer or red-eye reduction. To save power, the camera automatically enters a sleep mode after 16 seconds and may be reactivated by partially depressing the shutter. It's one of only a handful of digital cameras without a built-in tripod socket.

Taking pictures is as simple as

it gets: Turn the camera on, line up the subject in the viewfinder, and press the shutter. Downloading to a PC is just as easy, as the camera is built around a PC Card. Images turn out square-shaped rather than rectangular. The electronic flash illuminates a scant 7.5 feet, and there's no exposure compensation. Although Nikon's lenses are always sharp and deliver good contrast, the camera's relatively small pixel size gives it a maximum resolution of only 512-by-480, the least of all the cameras in this roundup.

The CoolPix 100's test images were muddy and indistinct. In fact, it almost seems as if everything was shot through a grey filter. The colors, though relatively accurate, were very muted. Although our test shots were disappointing, we were able to routinely capture very good quality up-close flash shots (2.5 to 5 feet) and brightly lit outdoor subjects.

Nikon CoolPix 100. Street price: \$490. Requires: 8MB RAM, 486 PC or better, Microsoft Windows 95, PC Card Drive. Nikon Inc., Melville, NY; 800-526-4566, 516-547-4355; www.nikonusa.com. *Circle 404 on reader service card.*

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First Looks

UTILITIES

Find Anything Anywhere on Your PC

Search'97 Personal takes you where no Explorer has gone before.—By David Haskin

Verity's Search'97 Personal for Netscape Navigator and Microsoft Internet Explorer is a browser-based search product that doesn't search the Web, but your PC. It of-

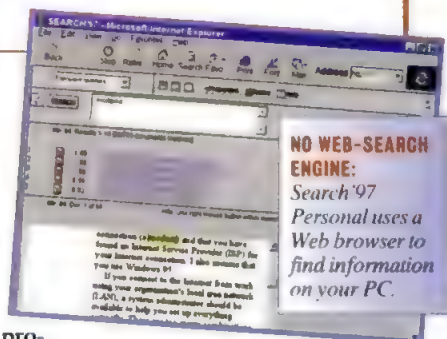
fers powerful and flexible tools to help you find virtually any kind of information. names of found documents in one browser pane—each document receives a relevancy ranking to help determine how closely it matches your query. In another pane, it displays the contents of found documents, with search terms highlighted.

Search'97 Personal also allows you to copy the contents of this WYSIWYG display onto the Windows clipboard.

IS personnel will appreciate the fact that you can customize Search'97 Personal with Verity's SearchScript language.

You'll need that scripting language to correct one significant shortcoming, though: By default, the program can't launch files and applications found by searches. Verity says that future versions will be able to launch applications without that modification. It also plans to add Web search capabilities in the next version.

Search'97 Personal's use of Verity's highly regarded search engine and its script language make it an impressive tool for helping corporate end users find locally stored information quickly



Search'97 Personal for Netscape Navigator and Microsoft Internet Explorer. List price: \$49.95. Requires: 16MB RAM, 40MB disk space, Netscape Navigator 3.0 or Microsoft Internet Explorer 3.0, Microsoft Windows 95 or Windows NT 3.51 or later, HP-UX 9.x, Solaris 2.3 or later, SunOS 4.13 or later, AIX 4.1 or later, Digital Unix 3.1 or later. Verity Inc., Sunnyvale, CA; 800-935-6246, 408-541-1500; www.verity.com. Circle 409 on reader service card.

FIND YOUR WAY: You can create agents that customize the appearance of Search'97 Personal and pre-create commonly used searches.

fers powerful and flexible tools to help you find virtually any kind of information.

Search'97 Personal builds its interface into either Navigator 3.0 or IE 3.0 and is available for many of the platforms those browsers support. We looked at the Windows 95 version.

Like most information-retrieval products, Search'97 Personal indexes your data files for speed searching. Not only does it search for local text-based information, it can also act as a client for Verity's enterprise information systems.

This product can index 200 file types, including HTML and all common word processing, database, spreadsheet, and presentation-graphics formats. In addition, it indexes Adobe Acrobat .PDF portable documents and messages stored in Eudora as well as in Navigator's and IE's e-mail programs. Unfortunately, it does not index the contents of Microsoft Exchange client folders.

Search'97 Personal's retrieval tools include natural-language queries, support for the Boolean AND/OR/NOT modifiers, and proximity searches for finding one word within a certain distance of others. It lists the file-

MATH SOFTWARE

Easier Equations

New spreadsheet add-ins strengthen MatLab programming tool.—By Barry Simon

The Mathworks' \$1,795 MatLab has long been a major mathematical software solution for scientists, engineers, and financial analysts. Version 5.0 introduces a bevy of new programming builds, including a kind of object-oriented programming. But it's also a product whose add-ins are more valuable to other scientific niches than the features the product offers on its own.

Bolstered by the Image Processing and Signal Processing toolboxes (\$895 and \$395 extra, respectively), MatLab is among the top choices in the scientific visualization field. And

with its Simulink add-in, MatLab is a leading product for the simulation of differential equations.

The new version features an extended Symbolic Toolbox (\$595 extra) that includes the full

Maple engine, whose functionality is totally available to your text files (called "m-files"). MatLab's programming language can be accessed via m-files or interpreted command-line environments.

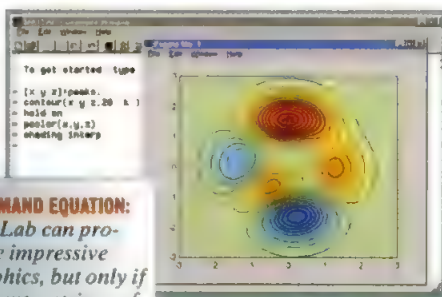
MatLab has also added multi-dimensional arrays and case statements. Its basic entities are

consists of thousands of hyper-linked documents. Macros supplied with a Microsoft Word template let you enter MatLab code and graphics in the middle of a Word document.

Though the language is more flexible, the user interface remains primitive. Virtually everything is controlled via command-line text input. You can change the lighting or viewpoint of a 3-D graphic, but only by issuing commands. You can't do this visually or by using menus or dialogs.

There are many new features in this version of MatLab, so users will certainly want to upgrade. If there's a toolbox that meets your needs and your budget can afford the price of the program and toolboxes (which are the program's chief strength), then look no further.

MatLab 5.0. List price: \$1,795. Requires: Microsoft Windows 95 or NT 3.51 or later, 8MB RAM (16MB recommended), 25MB to 120MB hard disk space. The Mathworks, Natick, MA; 508-647-7000; fax: 508-647-7101; www.mathworks.com. Circle 410 on reader service card.



COMMAND EQUATION: MatLab can produce impressive graphics, but only if you enter strings of text commands.

matrices, which are 2-D arrays. Since a bitmap is a 2-D pattern, MatLab, in turn, can manipulate images. Graphics are strengthened with Greek symbols, multiple y-axes, pie charts, and lighting effects. The HTML-based help file

Introducing the MessagePad 2000, the only handheld computer you can actually use.

Of all the handheld computers, only the MessagePad 2000 offers sharp, crisp backlighting and a 16-level, high-resolution gray-scale screen that rotates on command. Which means you can always see your work in the best orientation — horizontal or vertical, even upside down. And in the best light. Bright. Or dim.

The MessagePad 2000 gives you more flexibility, thanks to its two PC slots (other handhelds have only one slot). So, for example, you can dedicate one to a wired or wireless modem and use the other for additional memory.

How much can you do in three to six weeks? That's how long a set of AA batteries lasts under normal usage. Note: normal usage here means a lot. Like having backlighting on, using the modem, crunching numbers, writing e-mail, drawing, doodling, whatever.

Built-in software lets you connect directly to a variety of serial, IrDA and LocalTalk® printers — unlike most Windows® CE devices, which have to be hooked up to a PC in order to print.

There's fast. And then there's fast. The MessagePad 2000 comes with a screaming 160 MHz RISC processor, which offers up to five times the performance of the 20-40 MHz processors you get with other handheld devices.

The usable area of the MessagePad 2000 screen is up to 56% larger than what you'll find on most Windows CE products. So, instead of having to decipher small sections at a time, you can read the entire width of a fax or Web page.

A built-in microphone and speaker let you record and play back voice dictation. And the MessagePad 2000 is the only handheld computer that lets you record and take notes simultaneously.

The MessagePad 2000 works easily with desktop computers. So you can create documents on the MessagePad 2000, then transfer them to and from Microsoft® Excel or Word on any Windows or Mac® OS-based system. Or you can keep your calendar and address book current by synchronizing them with desktop programs like Microsoft® Schedule+ 7.0 or Claris® Organizer® 2.0. And it's easy: with Auto Dock, the MessagePad 2000 makes these transfers automatically.

Unlike Windows CE-based devices, MessagePad 2000 is the only handheld computer that lets you exchange data with both Windows and Mac OS-based computers.

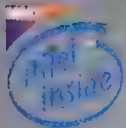
The MessagePad 2000 handheld computer offers a real detachable keyboard (not a tiny, finger-cramping version). So you can quickly and easily type e-mail, business letters, project reports. Only your superb writing style — not your aching fingers — will determine the length of your documents.

Of all the handheld computers out there, only one makes it truly easy to be productive on the road. Introducing the MessagePad® 2000. Rather than just letting you view data, the MessagePad 2000 lets you carry out sophisticated tasks with the greatest of ease. For example: you can now write a full-length proposal, insert information downloaded from the Web — even include pricing from your company's Intranet — and then fax or e-mail it to a client. Try that with an ordinary handheld computer. The MessagePad 2000 has more power, more storage, more flexibility. All contained within the most innovative design, optimized for usefulness. Of course, there's only one real way to understand how incredible the new MessagePad 2000 is: try it yourself. For the name of a dealer near you, or to get more information, call 800-909-0260. Or visit us at www.newton.apple.com/useit.





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First Looks

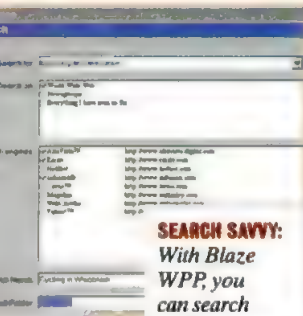
WEB UTILITIES

Blazing a Slow Trail

Blaze Web Performance Pack is a great Web organizer, but it falls short on its name.—By David Haskin

When it comes to the Web, it's impossible to be too fast or too organized. The \$50 Blaze Web Performance Pack (WPP) contains a useful set

of tools for staying organized and finding what you need on the Web, but its attempts to increase speed don't yet succeed. Blaze WPP's biggest strength is its search skills, which you access through its Windows Explorer-like Organize applet. Organize serves as a front end for querying eight popular Web search engines, including Excite and AltaVista. Handily, it translates your queries into the correct syntax for each engine, so there's no need for you to learn them all. It removes duplicates found by multiple sites, and you can save searches and schedule them for automatic updating. In addition, Blaze WPP automatically indexes the text in sites you visit so you can find information within them—you can also launch searches for such information from Organize.



SEARCH SAVVY: With Blaze WPP, you can search the Web using up to eight search engines.

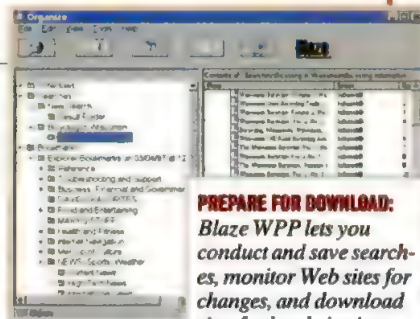
You can import Netscape Navigator bookmarks or Microsoft Internet Explorer favorites and set Organize to monitor them for changes and download them for local viewing. But if Organize detects changes, it places an icon next to a site's listing but won't automatically download them.

Blaze WPP's attempts to increase access time to Web sites don't do much—yet. After loading its Proxy applet, Blaze WPP works in the background to download pages linked to your current page. On our tests, this sometimes caused linked pages to display faster. Nonetheless, since by default it only prefetches one page at a time, it often doesn't improve speed. Datalytics also claims Blaze WPP

increases speed with an efficient page-caching scheme, but we found that neither speed-up scheme created significant improvements.

Web-access speed for Blaze users will improve with the addition of newly released xSpeed Web server technology from Datalytics. If you often search the Web, Blaze Web Performance Pack provides a comprehensive set of tools for managing and organizing the information you find there. But keep in mind that titles can be deceiving, as Blaze doesn't live up to its speedy name.

Blaze Web Performance Pack 1.1. List price: \$50. Requires:



PREPARE FOR DOWNLOAD: Blaze WPP lets you conduct and save searches, monitor Web sites for changes, and download sites for local viewing.

8MB RAM (16MB recommended), 6.5MB hard disk space (10MB recommended), Microsoft Windows 95 or Windows NT 4.0, Netscape Navigator 2.0 or higher, Microsoft Internet Explorer 3.0 or higher. Datalytics Inc., Dayton, OH; 888-497-3282, 937-226-7700; www.speeditup.com. Circle 411 on reader service card.

MATH SOFTWARE

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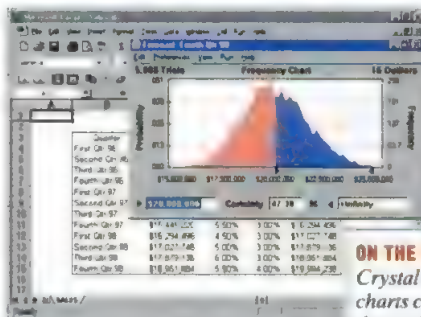
Spreadsheet add-in helps you make sound business decisions.—By Craig W. Stinson

Decisioneering's \$495 Crystal Ball add-in for Microsoft Excel and Lotus 1-2-3 enables you to quantify the future's uncertainties by helping you manage the risks associated with business decisions.

Before running a simulation, you must set up a worksheet model and identify all cells containing uncertain values (such as inflation, interest rates, currency exchange rates, and expected market share). For each variable, you specify the parameters of the uncertainty using any of 17 statistical distributions (normal, uniform, triangular, and so forth). Crystal Ball then repeatedly plugs random numbers into the uncertain cells, calculates their effect on output cells of interest, and tabulates the results.

After running a specified number of iterations, the program serves up graphs and statistics to assess your risks and make informed decisions. For example,

these graphs can help you estimate the likelihood that a new product or venture will break even. They can also provide after-the-fact rationales for decisions that may not have borne fruit.



ON THE CHARTS: Crystal Ball charts can easily determine sales probability.

Version 4.0 offers several improvements over previous versions, the most substantial of which is distribution fitting. Choosing the probability distribution that is most appropriate for the uncertainty in your model is critical to successful simulation. Although Crystal Ball's documentation provides both textual and mathematical explanations of each available distribution, getting this part of the model right still requires sta-

tistical expertise. If you have historical data, Crystal Ball can apply each of its continuous distributions against that data to determine which provides the best fit.

Another enhancement allows you to overlay the outcome of successive simulations on a single graph. Thus you can try the simulation using different assumptions and compare the results on an overlay chart. Other additions in Version 4.0 include a new distribution type and some alternative ways to specify certain distribution parameters. For example, you can now specify the end points of a triangular distribution using percentile figures instead of absolute numbers.

Crystal Ball's competitor, Palisades Software's @Risk, offers a few distribution types not present in Crystal Ball and custom XLM

macro functions (an extra-cost item for Crystal Ball users). **Crystal Ball 4.0.** List price: \$495. Requires: 4MB RAM, 1MB hard disk space, Microsoft Windows 3.0 or later, Microsoft Excel 4.0 or later, Lotus 1-2-3 for Windows, Version 4.0 or 5.0. Decisioneering Inc., Denver, CO; 800-289-2550, 303-534-1515; www.decisioneering.com. Circle 412 on reader service card.



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UTILITIES

Nuts & Bolts: A True Norton Alternative

Helix Software's new tool collection tops Norton Utilities.—By Edward Mendelson

Hidden behind the simple menu of Helix Software's Nuts & Bolts is a treasure chest of utilities that maintain, repair, and optimize every detail of your Windows 3.x or 95 system. Street-priced at \$50, Nuts & Bolts surpasses Symantec's Norton Utilities in power, flexibility, and range. Despite some minor interface glitches, it jumps to the top of the list of the utility packages that every safety-minded Windows user needs.

Nuts & Bolts comprises thirty separate DOS- and Windows-based utilities, accessible either from the package's own menu program or from shortcuts on the Windows 95 Start Menu.

UTILITY WIZARDRY

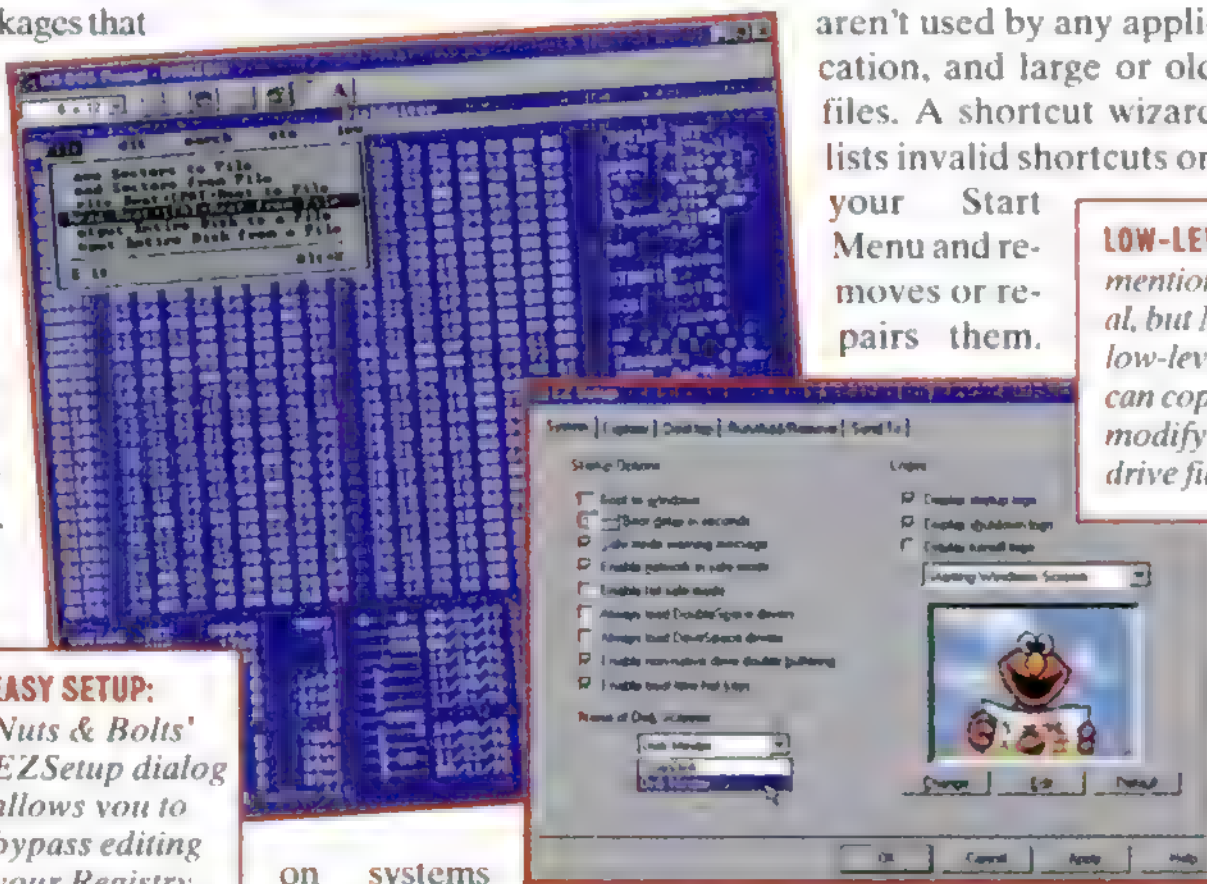
All the Windows-based Nuts & Bolts modules can be run from a wizard-style interface suitable for beginners, but almost all include conveniences and customization options not found in rival packages. Installation is straightforward, although you'll have to ignore the on-screen instruction to find the serial number on the disk and get the number from the registration card. Also, you can't install any less than the package's full 16MB of files. Unlike Norton, Nuts & Bolts doesn't complicate your system by loading files listed only in the depths of the Windows Registry. Instead, all files are installed in a single directory, and the utilities that you select to run in the background are loaded through the standard Windows start-up group. The package includes a utility that lists all the programs that run when you start

Windows; you may be surprised to find how many are loaded through Registry settings that you didn't know were there.

Nuts & Bolts' repair and recovery group includes a disk-testing and repair program that's faster and smaller than Norton's Disk Doctor, more effective on compressed drives, and less likely to report nonexistent errors

disk for fastest access. A Registry cleaner (installed only on Windows 95 systems) is the only Windows-based tool that removes empty blocks from the Registry for faster bootup; it also finds orphan registry entries and removes little-used entries. A cleanup wizard lets you selectively remove duplicate files, "orphan" files that aren't used by any application, and large or old files. A shortcut wizard lists invalid shortcuts on your Start Menu and removes or repairs them.

Among the utilities in the prevention and protection group is a crash-protection program that intercepts more Windows errors than comparable programs from other vendors. But like all such programs, this one cannot prevent all of the blue-screen crashes caused by badly written Windows drivers. A licensed version of Cheyenne AntiVirus performs basic virus detection and removal functions; the virus scanner in the Norton Utilities only detects but doesn't remove viruses unless you have Norton AntiVirus installed in addition to the Norton Utilities. Nuts & Bolts' equivalent of Norton's System Doctor has multiple performance gauges, but it adds a feature that notifies you when content changes at a remote Web page.



EASY SETUP: Nuts & Bolts' EZSetup dialog allows you to bypass editing your Registry.

on systems with removable drives.

Other utilities in the repair group resemble Norton's, but they are generally easier and faster. One creates an "image" of the disk structure so you can restore files if a directory or file allocation table gets scrambled; another creates a rescue diskette for repairing your system if it's too damaged to boot from the hard disk. A detailed system-reporting tool tells you more about your system than any other tool, but hides arcane details unless you select an option to display them.

A cleanup and optimization group includes the best available disk defragmenter, with unique options that let you position free space anywhere on the drive and move Windows or other files to the front of the

SYSTEM MANAGEMENT TOOLS

The system management tools include a system control program that includes most of the customization features in Microsoft's freeware TweakUI, but it also lets you add or remove start-up programs, specify Windows start-up and shut-down screens, and decide which disk scanner Windows will use when it tests your disk during a reboot after a lockup. Other programs in this group include a file shredder and a high-security encryption utility. A .ZIP-file manager and an icon palette for launching apps completes the Windows-based part of the package.

The DOS-based disk editor isn't mentioned in the manual, but it allows you to view and modify the file structures of compressed drives—something Norton's DiskEdit doesn't even attempt.

The major weakness of Nuts & Bolts is its inconsistent keyboard interface. You won't find one-letter shortcut keys anywhere, and you'll have to use the Tab key to navigate all menus if you prefer the keyboard to the mouse. Command-line switches are documented incompletely and only in a help file; Helix promises to post more detailed information on its Web site.

Nuts & Bolts lacks a few of the Norton Utilities features, such as the ability to track changes to the Registry and compare files, but the vast power, compatibility, and convenience of the new package puts Norton in the shade.

Nuts & Bolts. Street price: \$50. Requires: 8MB RAM, 20MB hard disk space, Microsoft Windows 3.1 or later or Windows 95. Helix Software, Long Island City, NY; 800-451-0551; 718-392-3100; www.helixsoftware.com. Circle 405 on reader service card.

LOW-LEVEL: It's not mentioned in the manual, but Nuts & Bolts' low-level disk editor can copy drives and modify compressed-drive file structures.



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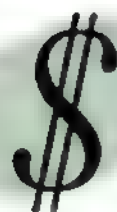
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First Looks

WEB UTILITIES

The Future of Downloading

There's a revolutionary way to distribute software from your Web site.—By Jay Munro

The traditional drill of downloading a .ZIP or executable file from the Web (which may contain files already on your system) and setting up the software locally may soon become extinct. By downloading files as needed, you can get what you want quickly and efficiently; the ability to install these programs directly from the Web is also a big plus. InstallFromTheWeb, Wise WebDeploy, and Net-Install use slightly different concepts, but each allows you to distribute your software easily.

INSTALLFROMTHEWEB

InstallShield Software Corp.'s InstallFromTheWeb (IFTW) uses a developer's existing setup program so you can install it directly from a Web page. Using a Netscape Navigator Plug-In or ActiveX control, IFTW runs the setup as if it were being run locally, but the product doesn't require users to download everything first. If the setup is interrupted, you can restart where you left off—a welcome feature given the reliability of Web connections.

IFTW is basically a client-side product. Its installations can be maintained remotely, which means you must have write access to upload files as well as a MIME type set on your server. IFTW is easily configured if you have Administrator access to the server; if you don't, you should consult with your Admin or ISP.

Once your server is configured, running IFTW is simple. To move your own installation program to the Web, IFTW's design-time wizard walks you through seven steps in which you specify the source and destination paths as well as the URL where your installation will reside. IFTW automatically builds a Web page using title and description infor-

mation gathered from the wizard. This product works best when run on the server itself, but if you are working on a local machine, IFTW populates a staging directory, which is then uploaded to its mirror on the actual server.

Though not available in time for testing, the company's flagship product—InstallShield 5.0—will provide an IFTW option that creates a more granular set of installation files, making downloads and recoveries more efficient.

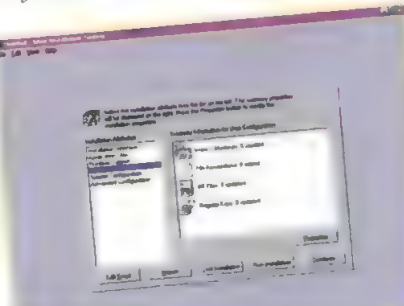
InstallFromTheWeb. List price: \$395. Requires: 12MB RAM, 10MB hard disk space, Windows 95 or NT 4.0, Microsoft Internet Explorer 3.0 or Netscape Navigator 2.0 or later (needs ActiveX or Netscape Plug-In capability). InstallShield Software Corp., Schaumburg, IL; 800-374-4353, 847-240-9111; www.installshield.com/iftw. Circle 406 on reader service card.

WISE WEBDEPLOY

Great Lakes Business Solutions' Wise WebDeploy, an add-on to its Wise Installation System (First Looks, February 20, 1996), installs as a new tab under the advanced configuration dialog box. WebDeploy takes a slightly different approach to distribution: It requires no interaction with the server other than uploading files.

WebDeploy works by breaking up your installation into a series of files, with a main setup.exe and a series of files numbered .001, .002, and so forth. On your Web page, link to the setup.exe file. When users click on it (depending on how

they have configured their browsers to handle executable files), the file can either be run or downloaded. The main setup executable begins, which in



LOAD AND GO: Wise WebDeploy requires no interaction with the server once your files are uploaded.

turn connects to the site where files reside. At this point, it becomes a standard Wise installation, and only those files that are necessary are actually downloaded.

To create a Web installation using Wise, you'll need to know the root address and directory of where your files will reside on the server. From the WebDeploy tab, you then fill in the required fields, which include host address, user name, password, host directory, cluster size, and file protocol. To create an installation address of www.pcmag.com/bogus/download/myfile.htm, enter www.pcmag.com for the host address and bogus/download as the host directory. Then you can create a Web page called myfile.htm for your installation. From there, copy the files onto your server (either directly or with your favorite FTP program).

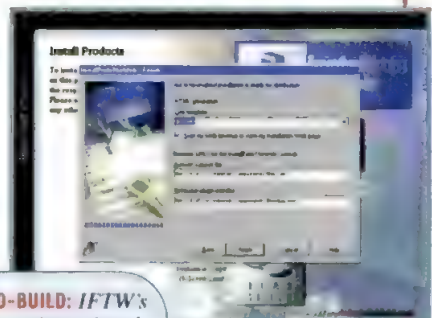
Wise WebDeploy. List price: \$169. Requires: 8MB RAM, 1MB hard disk space, Windows 3.1 or later, Windows 95, Windows NT 3.51 or later, Wise Installation System 5.0. Great Lakes Business Solutions, Canton, MI; 313-981-4970; www.glbs.com. Circle 407 on reader service card.

NET-INSTALL

Net-Install, from 20/20 Software, uses either a Netscape Plug-In or an ActiveX component to install files directly from the Web. Unlike WebDeploy and IFTW, Net-Install is a complete install creation program.

Working from scratch or using the QuickBuild utility, the programmer creates installation scripts or config files (.CFG) that are converted to installation (.INS) files for deployment. On the server side, a mime type must be set so your browser recognizes the .INS file and uses the right Netscape Plug-In or ActiveX component.

Net-Install includes all the basics for installation, such as settings for minimum amount of hard disk space needed, CPU type, and target directory. It also includes config.sys, autoexec.bat, and .INI-file modifications as well as informative messages and graphics for installation. Those who want more control can customize scripts to include additional registration content, user prompting, file group creation, file deleting and renaming, and dozens of system, logical, and string variables and commands.



AUTO-BUILD: IFTW's design-time wizard automatically builds its own Web page.

For programmers targeting the Web as their primary distribu-

tion medium, Net-Install is worth a look.

Net-Install. List price: \$299. Requires: 4MB RAM, 2MB hard disk space, Windows 3.1 or later, Windows 95, Windows NT 3.51 or later. 20/20 Software Inc., Beaverton OR; 503-520-0504; fax 503-520-9118; www.twenty.com. Circle 408 on reader service card.

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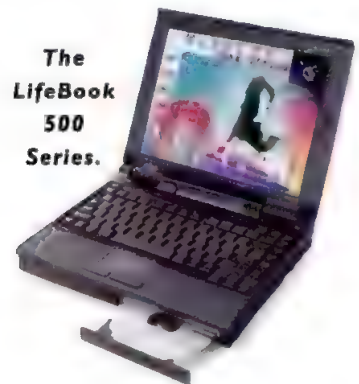
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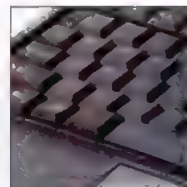
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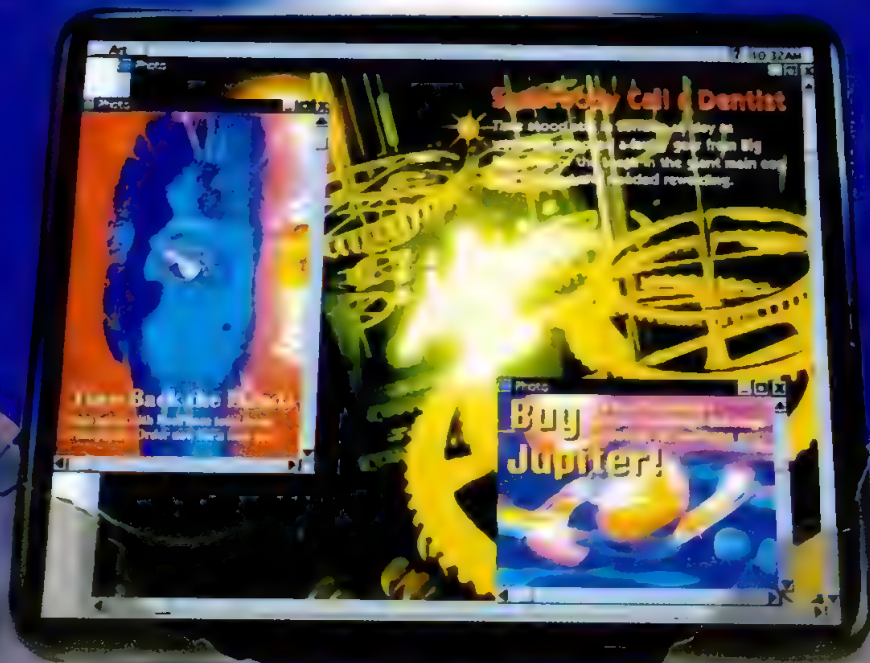
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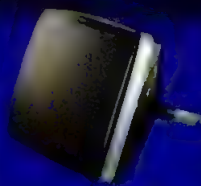
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Second Looks

PDA SOFTWARE

Hands Across the Office

The Handheld PC Explorer (H/PC Explorer) allows you to move data between your Windows CE handheld PC and your desktop system. In addition to providing synchronization services (so that the diminutive Win CE system is always stocked with updated documents), Microsoft's H/PC Explorer converts files to the native formats of many of Windows CE's Pocket applications. With the original Windows CE release coming before the advent of Microsoft's Office 97, the H/PC Explorer wasn't set up to deal with Office's new file formats.

If you have a Windows CE machine, scurry over to Microsoft's Web site and download the beta release of H/PC Explorer 1.1 (www.microsoft.com/windowsce/hpc/software/hpcexplorer.htm). The 3.8MB download extends the usefulness of this handheld device by enabling it to understand and translate some—but not all—Office 97 formats. We feel it's a step in the right direction toward making Windows CE a more credible platform. For example, moving files to and from the desktop and H/PC is as easy as dragging items between the H/PC Explorer and the Windows 95 Explorer panes and waiting for the data to be converted and moved via the PC-to-CE serial link.

What you see may not be what you get, though. On our test, the resulting Pocket Word document turned out to be uniformly less than what was sent. Although the file typically retained such typographic features as an initial drop cap and some

font styling, it ended up without justified margins or page breaks. The conversion process rendered embedded Web URLs as underlined text. Be-

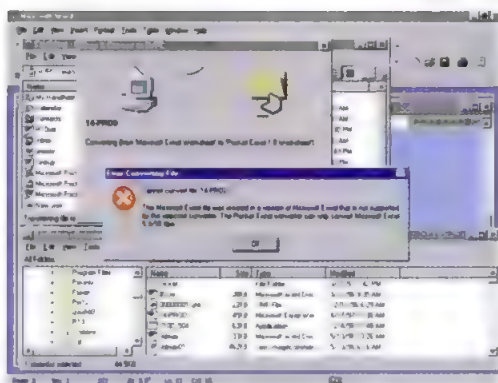


IMAGE EDITING

Learn As You Go

When we first reviewed Adobe's PhotoDeluxe, we were delighted with its high-end, easy-to-use features. Such features allowed us to do everything from removing a facial blemish from a portrait to adding a blur onto the back of a picture (First Looks, October 8, 1996). Despite Adobe's Photoshop emphasis on professional image-editing tools and printing-press-ready results, PhotoDeluxe can turn just about anyone with a digital camera or scanner into a PC artist.

The more we used Adobe's PhotoDeluxe, the more we liked it. Our favorite parts were the project-oriented activities,

warned: All the formats and features that get lost in the trip from the desktop to the Win CE system won't reappear when the file is transferred back to the desktop PC.

A 40K Word 97 file glided from a 200-MHz Pentium PC to an NEC MobilePro 400 in about 20 seconds via a serial port connection. Along the way, the file was reduced in size to just 10K, which is a much more equitable size for a system that holds a mere 4MB of memory.

Although the new software does a consistently good job with Word 97 files, translating Excel 97 files was a mixed bag. For ex-

which guide you through creating printed material. For several helpful tips and techniques, you should go check

ample, H/PC Explorer was totally confused by complicated files, particularly those with embedded charts. On the other hand, simple worksheets went through without a hitch. Don't expect this situation to improve until a future release of H/PC Explorer. In addition, the program cannot work with Lotus 1-2-3 or Corel WordPerfect files.

The H/PC Explorer 1.1 also fills an important gap as far as support for Windows NT goes. The beta software that we looked at worked just as well at moving files to and from an NT system as it did with a Windows 95 PC. So for the ever-important job of safely moving and converting files between desktop and Windows CE systems, don't leave home without the H/PC Explorer 1.1.

will also learn how to create a multilayered poster. Each task should take you no more than ten minutes to complete.

These guided-tour projects produce impressive results. But in a larger sense, they go a long way toward teaching you how to use the program's special effects and filters, even if you are among the graphically challenged. Along with printing your creations, you can export any of these projects in Acrobat portable document format, which is perfect for displaying them on your family's Web page or in an e-mail message to your grandmother. Look for the site to be periodically updated with new projects.

SECOND LOOKS MAILBOX: Tell Second Looks about your experiences with computer products. Contact Carol Venezia at cvenezia@zd.com.



out the company's Web page at www.adobe.com/proindex/photodeluxe/main.html. These tips provide you with some excellent ways of learning the ins and outs of PhotoDeluxe, and they will help you produce some high-quality output.

For example, you will find instructions on how to create a GIF animation sequence that shows a baby's head emerging from a colored egg—perfect for Web greeting cards. You

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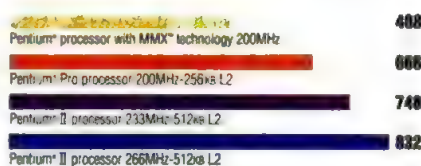
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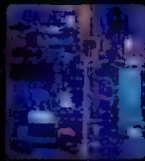
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Living with the Look-Alikes

I used a Cyrix 6x86 computer from the time the chip was first offered until recently, when I bought an AMD K6. With the Cyrix's 32MB of RAM, Imagine 128 graphics card, and 2GB Seagate Barracuda hard disk, it was a great graphics machine—strong

enough for Corel PhotoPaint—with only one problem: an inability to run Power Tracks Pro and Band-in-a-Box in their notation modes. But Intel chips are a well-known quantity; I enjoy learning about the compute-alikes firsthand.

Everything was fine until I decided to clean the glop out of my mouse after it started misbehaving. I must have delivered a static shock to it and hence to the keyboard controller, because after I put the mouse back together, neither it nor the keyboard worked. I rebooted the machine in the hope that the logic had gotten temporarily scrambled. No such luck. During the boot sequence, I got the ever-helpful message "Keyboard Error, Press F1 to Continue." I dutifully pressed the key, but the computer wasn't listening, nor would it ever listen again through that controller.

So much for cleaning the mouse while the computer is on.

When I took the cover off the machine and looked at the motherboard, I saw that the controller was an AMI Anykey-2 and that it was socketed, a small surprise since these chips are usually soldered down. A new chip and I'd be back in business.

It was Friday afternoon, too late to start calling around. The next day, my son Andrew and I checked the local paper for computer shows, figuring that these freewheeling, flea market-like testaments to capitalism would be the best place to find either a new controller chip or a whole new motherboard. Two of them were running in the area. I'll spare you the details of the torrential rains and the U-Haul stuck under the railroad bridge, but we finally got to both shows. Apart from size, they were virtual replicas of one another. I soon discovered that nobody was selling loose chips other than microprocessors, so I focused on replacing the motherboard while Drew looked for a copy of Rebel Assault II.

I brought the fried motherboard with me and began making the rounds among the vendors. But I soon realized that everybody had the same three brands, which weren't good replacements for mine and would have required drilling new holes in the case for the keyboard and mouse

plugs. Most of the vendors were utterly uninterested in whether I bought a board. Only one took the time to look at my motherboard; he determined that it had been made by Phoenix and said he would call after he learned whether a replacement was available. To my surprise, he did call a

couple of days later but said that his suspicions were confirmed: My motherboard was a limited-production item and no longer available.

By then, my attention had shifted to the machine AMD had sent me, a 233-MHz K6 with 64MB of RAM, a Matrox Millenium graphics card, and a 4GB Seagate Cheetah hard disk. Simply put, this is one of the fastest single-processor machines you can lay your hands on. It came loaded with Windows NT, and it really blazed, turning in Business Winstone scores of 72 to 73. (Windows NT is just the ticket if you're going to be running modern, 32-bit business and technical applications. It's fairly useless as a home operating system, though, with its nonexistent game support and limited Plug and Play capabilities.)

I had a heck of a time loading Windows 95 on the thing, because Win 95 didn't want to load the driver for the DPT SCSI controller. Every time Win 95 loaded, the CD-ROM would disappear. The guys at AMD finally built me a disk with everything I needed.

The K6 is a screamer in more ways than one: The combined howl of the four fans and the 10,300-rpm Cheetah hard

disk makes it a voluble companion in the home office. Even the 12X CD-ROM drive adds a note to the symphony. The fourth fan, a high-velocity job, is there to handle the heat that the Cheetah generates. This disk is an expensive—but fast—way to keep your feet warm.

The Cyrix machine's absence brought the development of my Web site (www.billsbest.com) to a screeching halt. In the interests of getting back on the air, I popped the Barracuda hard disk into the Cyrix machine. Although I had to reinstall the applications, at least I had the data back online. They don't call it "the bleeding edge" for nothing, but I wouldn't live anywhere else. □



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The Intel/AMD War Rumbles On

Few people understand that AMD's K6 chip is not like other clones made by various manufacturers but represents a cost-effective design departure that will seriously threaten Intel's current dominance. This chip parallels the emergence of the Z-80

microprocessor in the 1970s—a chip that took the market by storm.

The most interesting similarity between the Z-80 and the K6 is that each design team was led by an Intel superstar who quit the company. In the case of the Z-80 it was Federico Faggin, a primary architect of the Intel 8080. For the K6 it is Vinod Dham, the head of the Pentium project. This coincidence is not lost on Intel. For both the Z-80 and the K6, a certain design elegance was largely responsible for the difference in chip architecture. At the recent rollout of the K6 you could see how the NexGen-AMD teams had rethought the process of how to build a microprocessor using modern techniques employed by ASIC and RISC designers.

The Z-80 was a success in the market for two simple reasons: price and performance. AMD claims that under all circumstances it will sell the K6 for 25 percent less than the comparable Pentium Pro. It appears that at the same clock speeds the K6, with built-in MMX technology, will outperform the Pentium Pro. The same should hold true for the Pentium II, which adds MMX.

AMD has wisely named the chip using the clock speed as the product identifier rather than the dubious P or PR rating initiated by Cyrix. I always thought that calling something a 166 only because it had performance similar to a Pentium 166 was a bad idea. Luckily, AMD engineers prevailed over marketing hype, and a K6-200 or K6-266 reflects true clock speed, not an equivalency of some sort. This allows AMD to take a leadership role and not worry about pegging its chips against Intel benchmark tests or CPUs. It's quite possible that AMD will leap ahead of Intel and do some serious market damage.

I've talked to Intel-centric computer makers, and they seem to think the chip will pose no real threat. But it does. The reason is that when tested one against another, the AMD-equipped machines should outperform similarly equipped Intel-based machines. This difference, along with price, will make Intel machines look less appealing over time. Why? Because the buying public is accustomed

to how magazines—*PC Magazine* as well as every other computer-related publication—rank machines according to performance. Something that is “not as fast” and “costs more” does not cut it in this market.

Intel will soon discover that its expensive “Intel Inside”

TV campaign may have no real benefit. AMD will mount a campaign of its own attacking the “Intel Inside” theme to counter any lingering effects. This market has always been preoccupied with price and performance. It also doesn't hurt AMD's cause in the short term that the K6 was designed to be Socket 7 (Pentium socket)-compatible, whereas the Pentium II needs a motherboard redesign.

The fly in the ointment for AMD is the (pre-NexGen) K5 and the ill will it created when it was found to be faulty. AMD is freaked by this and is overly cautious. You can be sure that from the moment the first K6 chip was sold, Intel got its hands on more than a few in an intense effort to find flaws. I'd be surprised if it can't find some minor problem in the chip that under some circumstance causes a compatibility breakdown. Intel needs to show *something* to its supporters. If it doesn't, then it must speed up its own development efforts to get out a P7 as soon as it can.

When Jerry Sanders, CEO of AMD, rolled out the K6, he reminded folks that AMD historically has had better process engineering than Intel. Holding up a huge Hershey's chocolate bar-size chip that supposedly has the same dimensions as the

Pentium II, he compared it with the compact K6 design. The K6 is more vertical, with six layers of metal as opposed to four in the Pentium II. Also, its innards are largely RISC and in some ways more like what we might expect from the next-generation Intel chip designed with HP—the P7.

This all adds up to a new round of chip wars. Many in the market don't recall the 286 and 386 wars. One “analyst” for an investment firm says this is the first time in its history Intel has ever been challenged. He's obviously just out of school. In fact, these battles are a tradition recently forgotten, as the 286 and 386 wars can attest. Now they're back.

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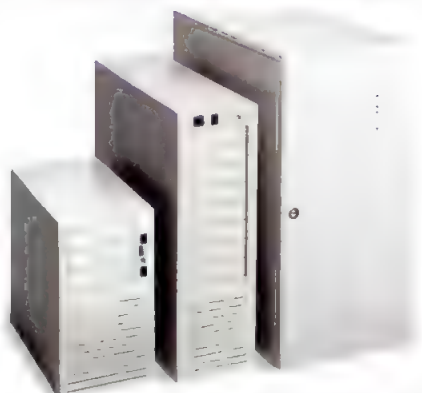


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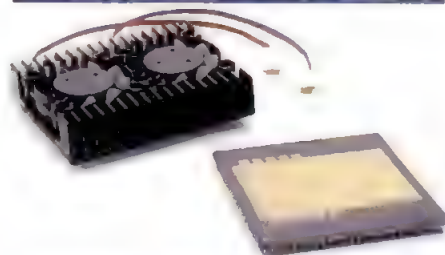


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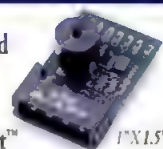
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Inside Track

Leapfrogging the Competition Dept.: As I watch the rejuvenated competition between Intel and AMD evolve, I wonder if Intel isn't getting ready to **pull a fast one** and jump the public to the P7 as quickly as possible. It seems that the current Pentium II—a package the size of a **large, thick Hershey's chocolate bar**—is just not workable. For this reason alone, it borders on the ridiculous. Others point out that it also requires a complete motherboard redesign, which many small motherboard makers would like to avoid. Look for Intel to go back to the drawing board with this.

Intel hopes it can keep cost down on new designs by adding more to the motherboard. It hopes that its partnership with Lockheed can spawn a new 3-D engine based on some **secret military designs**. The engine would be developed into a full-blown graphics display chip—placed on the motherboard—that might **replace your SVGA card**. This was tried before and disregarded because of the versatility of add-in cards.

Meanwhile, Microsoft's **recent themes** have been TV, TV, and more TV. J.C. Turner sent me this interesting observation: "So which do you think was most significant about the Compaq/Microsoft/Intel DTV Team's recent announcement at the National Association of Broadcasters convention in Las Vegas: the fact that it took place at Treasure Island, with its giant Jolly Roger out front, or that the high-definition example used in the demonstration was the *Waterworld* trailer? Just curious as to your thoughts on the matter."

My thoughts are that we're getting **a lot of mixed messages** from Microsoft. Whatever the case, the company seems intent on not **missing any more technology boats** like the one that left an Internet dock called the World Wide Web. So as this TV-convergence situation—which I was convinced **was dead**—reemerges, Microsoft wants to make sure it's a force if the technology becomes popular.

MS signaled its intent by buying WebTV for \$425 million. At WinHEC (Windows Hardware Engineering Conference) it showed **a new user interface** just for the TV platform with a menuing front end that looks like what you get on a **hotel room TV set**. Choices (on the computer screen) include television, movie, and CD music. At the show, MS also tossed out some **new buzzwords** and insults. One is ZAW, which stands for "Zero Administration for Windows"—part of the total-cost-of-ownership promotion. To **ridicule** Larry Ellison's Network Computer, Bill Gates dubbed NC "Not Compatible." In the meantime he introduced a compatible version of an

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NC device called a **Windows Terminal**, or Winterm or WT. The company also began using the term "thin client" in earnest, showing that it actually fears this NC threat although there is no evidence of one.

Perhaps the WebTV purchase will create a new front for the **browser and NC wars**. Microsoft also recently introduced a proposal for a **new standard to link TV networks** to the Internet, combining Web content and TV programming in some way. Sounds like the **old interactive-TV nonsense** repackaged with an Internet angle.

This attempt to make TV and the computer one and the same seems as if it will never die. The mania with which Microsoft is attacking this new front leads me to believe that some-

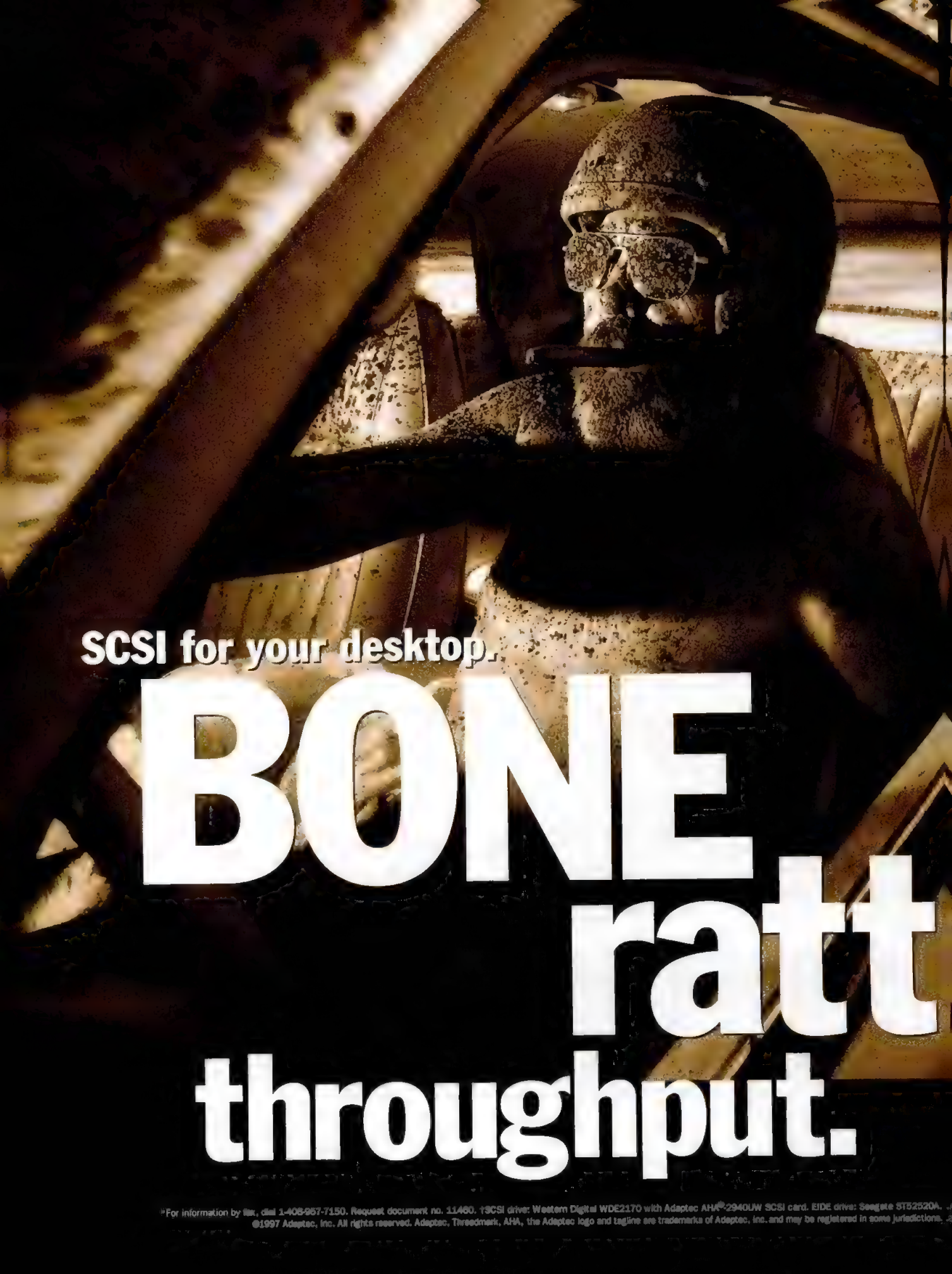
body somewhere wrote a compelling report with very impressive data. There is no other explanation.

Gates has also kept alive his notion to surround the globe with low-flying satellites for a telecommunications network. When you ask around as to how he (and partner Craig McCaw) plans to get on the waiting list to launch literally hundreds of birds, **a curious rumor** keeps cropping up. It's that **China** will be hired to do the launch. Gates seems to be getting **chummy with the Chinese**. Nobody can confirm this possibility, and it's even likely that Gates is only interested in keeping bogus Microsoft products from being produced in China, where much counterfeiting is done. The fact is that if Gates starts sending Microsoft profits to China to launch satellites, it could become a **PR nightmare**. Are Chinese rockets really that good? Well, I guess they invented the rocket, so maybe!

The Never-Ending DVD Saga Dept.: So now it seems that the DVD Consortium has finally agreed more or less on the format of the DVD-RAM, or recordable DVD. I thought an agreement was reached long ago, but apparently not. The recordable DVD will have a phase-change-type disk and a **2.6GB capacity** per side. Tracks are designed to meander mildly, which supposedly makes them easier to access. The technique is called *warbling*.

In Other Technology News: A company in San Francisco called OmniDimensional Systems is touting a 2GB solid-state memory using flexible foil found in CD-ROM disks. It intends to integrate thin-film transistors and diodes onto this material to make a product that is CD-ROM-like but **not mechanical**. Maybe it was a bad April Fools' gag, because that's very strange.

Finally, **the Amiga users of the world** are happy that Gateway 2000 bought the assets of the most recent Amiga owner, ESCOM. Whether any more Amigas will be made remains to be seen, but they have given the **new machine** a name already—the AMOOGA. □



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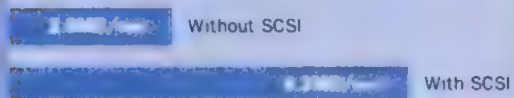
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Whom Can You Trustmark?

Last issue I wrote about the notion of electronic commerce, and what it's going to take for analysts' soaring estimates of the electronic-commerce marketplace to come true. As I said then, we need security, privacy, authenticity, and recourse to make online

commerce work on a wide scale. I'm convinced we're going to develop those, if less smoothly and comfortably—and probably less quickly—than many others predict.

The other side of the coin is the parallel notion of privacy. In the electronic era, the whole concept of privacy has changed. We've learned that we cannot participate in this brave new world as consumers without forgoing at least some of what we have traditionally thought of as our privacy rights. We give our names, addresses, telephone numbers, and credit card information to complete strangers—an act not fundamentally different from giving your Visa card to a waiter who then disappears for 10 minutes, but often perceived as riskier. In return, these strangers offer a variety of goods and services, some unavailable in any other context.

But it isn't the exclusivity of what we can find and buy online that leads us to breach our traditional notions of a personal-privacy wall around us. Instead, it's almost always *convenience* that tugs us across the line. Sure, we like the wide range of books available at Amazon.com or the hip bad-weather boots available from the L.L. Bean site. But we could buy essentially all of those books down the street at Barnes & Noble or Borders, and we could buy the boots through Bean's well-established mail-order catalog.

Instead, what we really love is the idea that we can sit down at our leisure, in our homes or on our lunch break, and leisurely peruse the immense virtual shelves of the virtual Amazon bookstore, or prowl through the virtual boots and fishing gear at good ol' L.L. Bean. Any time of the day or night. Without picking up the phone or getting in the car and driving to the mall. And we get the goods in just a few days—sooner if we're willing to pay for it.

Convenience is a powerful motivator. In an era of convenience stores, convenience foods, and convenience everything else, *convenience* has become a primary driver in many buying decisions. Electronic commerce clearly benefits from that societal trend. "E-mmerce" is, at least for now, the ultimate in shopping and buying convenience.

But is it important enough to persuade us to give up our privacy shields? Apparently so: As a society, U.S. residents spent maybe \$350 million online last year and will spend another \$500 million or more this year. Three years from now, the experts say, we'll be spending \$6.5 billion or more online—a classic hockey-stick growth curve.

What does it take to get from \$350 million to a figure 20 times as large? What inducements will online merchants have to offer to persuade us to play on that scale?

A primary job for the vendors will be to persuade us to keep giving them our personal information. Far from apparently moving away from caring about personal-privacy issues, I think we'll decide that as much as we like finding and buying things online, we don't want to give up much of that personal privacy. And we'll make that clear in our choice of the online merchants we support.

The absolute, fundamental, underlying facilitator for electronic commerce is *trust*. We have to be able to trust online vendors to deliver in a timely way the goods they describe, not shoddier replacements (or nothing at all); to handle our financial and other information discreetly, according to an explicit code of behavior; and to accept our returns and give our money back when we are unhappy with what we receive, whether our unhappiness arises from their error or our own.

It's the "handle our financial and other information discreetly" part that I want to focus on here.

One of the best things to come along so far in the electronic commerce world is the new eTRUST program. eTRUST is a set of standards to which online vendors may voluntarily subscribe. Participating vendors are audited by a national accounting firm, which examines in detail how they handle customer information. Vendors with sites that pass the audit, so to speak, get one of three eTRUST ratings, which allows them to post the appropriate eTRUST logo on their Web sites and use it in their advertising.

The categories are simple—probably, too simple.

The lowest or most basic level, *third-party exchange*, indicates that within certain limits and by ground rules



HONOR CODE

The absolute, fundamental, underlying facilitator for electronic commerce is trust.

JIM SEYMOUR

explained to customers who ask, the vendor nonetheless shares information with other entities. This is pretty feeble.

The middle level, *one-to-one exchange*, indicates that the vendor will keep and may use customer information, but only in interactions with that customer.

The highest level is the *no-exchange warranty*, under which a merchant agrees not to capture or keep information about customers' use of the site or any transactional data except that required for billing and system management. The merchant also agrees not to monitor or capture online chat on its site and not to capture or use tracking information about customers. This promotes, in eTRUST's words, anonymous usage and transactions.

eTRUST is a great idea, and I support it. I suspect many online vendors will, too. The problem with eTRUST is the breadth of its categories. In trying to make them clear, understandable, and appealing to customers and vendors, eTRUST has oversimplified the privacy issues. For example, its lowest-level trustmark, the "third-party exchange" certification, is so weak that it's more like a black mark on a merchant's record than a commendation. And "no exchange," the highest level, can make it almost impossible to run a business.

eTRUSTers are going to bunch up in the middle around the "one-to-one-exchange" standard. That's an improvement over today's formless, Wild West-style online-privacy environment, but it's probably not *enough* of an improvement.

There are also some implementation problems. Coopers & Lybrand, the biggest accounting firm backing eTRUST and handling eTRUST audits of applicants, apparently sees this as a huge revenue opportunity (fair enough), but has earned a black eye among some early eTRUST applicants for excessive fees (foolish and self-defeating). But remember that eTRUST is new, just now moving from a small-scale pilot program to wider recognition in the marketplace, and will surely iron out most problems with experience. Other accounting firms will participate, and market forces will tend to cap fees.

My reservations aside, I think eTRUST is a big step forward. The notion of a "Good Housekeeping Seal" of good business practices regarding customer-privacy issues is a welcome advance. Whether eTRUST proves to be the most widely recognized, most widely accepted imprimatur remains to be seen—but it has a big head start. □

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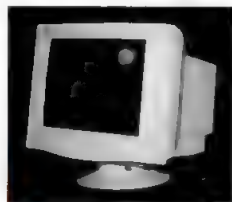
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The Technicolor Revolution

It's not just PCs that feel old and sluggish after two years. Color printers count their lives in dog years, too: Everything ages seven times as fast as in real life. This spring we're seeing new printers that further push the limits with better quality, faster

printing, more functionality, and lower prices. The improved quality may make you wish you could mothball your existing like-new printer.

Interestingly, Hewlett-Packard is among the leaders this time around. HP has always been the ink jet market share leader, producing what I think of as mainstream, white-bread printers, while Canon, Epson, and Lexmark have done the interesting products. But this winter and spring, HP brought out a breakthrough printer/copier/color scanner, a great color printer/fax, and a photo printer—and more is on the way.

The best, most interesting printer is the HP OfficeJet Pro 1150C, a \$1,000 (street) multifunction device. For starters, it's a fast printer (6 ppm text). It's also a good color scanner. And best of all, it's a color and monochrome copier. If you've never had a color copier in your home, small office, or workgroup, you'll be amazed at how many things benefit from being copied in color—and how many you actually will copy in color when you're paying about a dime a page for the ink. Compare that with a dollar a page or more for color copies in print shops.

The HP OfficeJet Pro 1150C has a couple of drawbacks. It's big, about the size of HP's 1984-era LaserJet. And it scans through the parallel port, a compromise—especially on speed—because HP didn't want users to have to open the PC to install a SCSI card, and because other connections such as the Universal Serial Bus aren't universal yet. Our testing in PC Labs found its flexibility a bit below that of some single-purpose scanners; however, I'd say the quality is certainly good enough.

One multiple function missing from the HP OfficeJet Pro 1150C is faxing. In the past, I believed a color printer/fax machine combo to be the perfect device for the home office, because it cut down on desktop clutter. But as more users want color scanning, the printer/fax combo doesn't cut it, because you get only medium-res monochrome scanning via the fax scanner. And now that passable plain-paper fax machines (the only kind to buy) are down to \$300, it seems less wasteful (except in terms of desk space) to have

both. Also, don't forget that a combo printer/fax device has to be tethered within about 6 feet of your PC (the length of the printer cable), which may not be where you want to locate the fax machine.

If you're interested in printer/fax combos, HP's new

OfficeJet 500 series (\$500 to \$600 street) is currently the most capable product, besting Canon's now-aging MultiPass C2500. Whichever firm ships most recently often has the best product, and that's currently HP's OfficeJet 500 series.

PC Labs will test color and multifunction printers this fall. But if you're buying a personal color printer before then, here are some suggestions:

- Think about the cost of printing, not the cost of the printer. Ink jet ink can break you. All other things being equal, bigger ink tanks yield lower costs per page. Higher-end ink jet printers, the ones that cost around \$500 to \$600, typically have bigger tanks. The total life-cycle cost of a \$500 printer with bigger tanks may be less than that of a \$300 printer with ink tanks the size of crack vials.
- Don't get hung up on resolution. More is better, but most isn't always best. Yes, you get wonderful photo-realistic images from Epson's 1,440-dpi printers, but that doesn't mean you won't get great images from 300- or 600-dpi printers that do a good job laying down their ink.
- Lots of people worry about what happens if a multifunction device breaks; then you're out a scanner, printer, and

fax machine. My advice: Don't worry. Fax machines and ink jet printers almost never break. Just keep feeding them paper and ink cartridges.

• Check out the business-oriented tabloid printers. Virtually every vendor has them now, and they print at least 11-by-17 sheets. They're great for big spreadsheets, or for creating four- or eight-page booklets using one or two sheets of paper. And several can print posters three or four sheets high and wide, automatically enlarging the image.

From now through year's end, expect to see an incredible variety of color printers, photo printers, multifunction devices, and high-end printers coming to market. □



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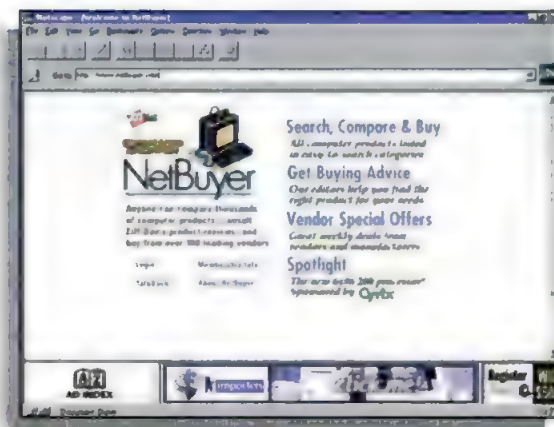
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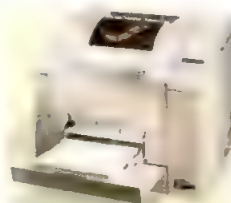
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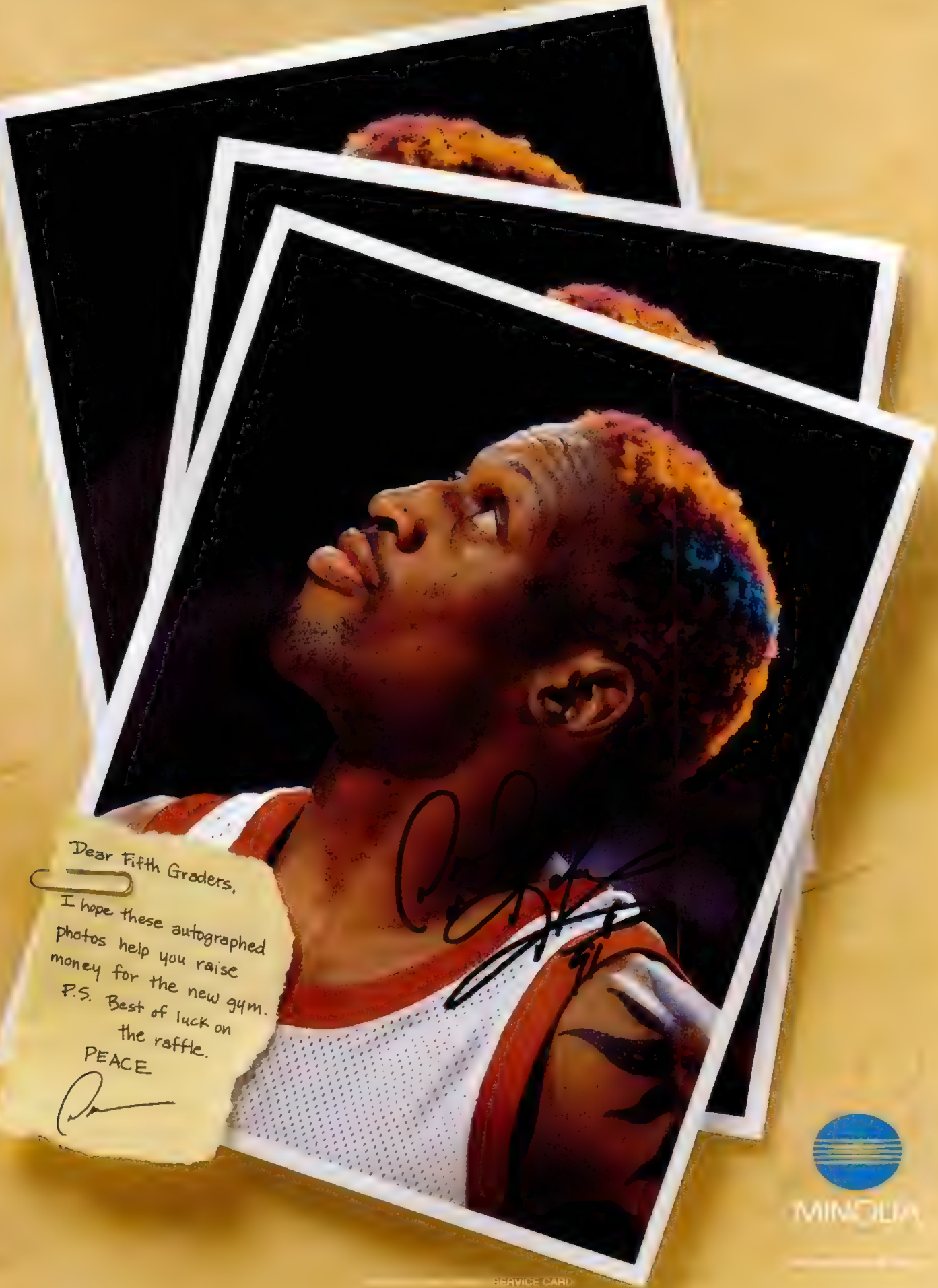
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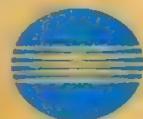


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money for the new gym.

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PEACE



MINDOLIA



MMX MEANS BUSINESS

If you've seen Intel's television commercial in which a group of space-suited lab technicians boogie to the beat of "Play That Funky Music," you might wonder aloud whether a PC with an MMX-enhanced Pentium processor in it could be a serious business partner.

Intel's MMX technology promises—and for the most part delivers—smoother

video and better audio, but it truly excels when combined with MMX-enabled software. Therein lies the problem: You'll have no trouble finding MMX-enabled entertainment titles, but the same cannot be said about business applications.

Can a business PC user benefit from an MMX Pentium PC today? The answers are elusive. In the end you may ask yourself, "Is this jive? Or is it MMX?"

Many of the 63 units we looked at for this roundup fall into two types: the true business PC with the necessary supporting hardware and software, and the PC with a full or toned-down home software package. While one can argue that any PC with a network card can be considered a business PC, a network manager might beg to differ. When it comes to maintaining a fleet of business PCs, network access isn't all you need.

DMI-COMPLIANT WHAT?

One of the hallmarks of a true business PC is compliance with the Desktop Management Interface (DMI) 1.1 specification. Theoretically, DMI 1.1 compliance allows you to inventory a PC's components and settings. Unfortunately, we found that making use of the features of DMI is easier said than done (see the sidebar "DMI, TCO, COA: Not Just Acronyms Anymore" for more details).

- Only 23 of the 62 vendors here claimed that their PCs were DMI-compliant. Others either didn't know what DMI was or simply made no such claim.
- Of those 23 vendors, only 8 (Compaq, Comtrade, Dell for its Optiplex, Digital, DirectWave, Hewlett-Packard, IBM, and Toshiba) provided a 32-bit service layer, which is necessary in order to manage the PC remotely (the DMI 1.1 spec doesn't support remote manageability).
- Of these 8, we found that HP's TopTools—packaged with the Editors' Choice-winning HP Vectra XA 5/200—was the most elegant and robust solution.

The future DMI 2.0 spec may lead to shrink-wrapped management solutions, but it isn't expected to be adopted before the end of this year.

MMX SOUNDS OFF

Intel's MMX Pentium CPUs include 57 new instructions designed to enhance audio and video performance. Intel trumpets them as the single largest addition to x86 architecture since the 386. A key fea-

ture when combined with software that takes advantage of the new instructions. While entertainment software publishers have moved swiftly to take advantage of MMX, business software vendors have not. A glance at a software list on Intel's Web site (www.intel.com) reveals that most MMX-ready titles are aimed at photo editing (like Adobe PhotoDeluxe or Microsoft Picture It!), audio editing (like Roland Virtual Sound Canvas VSC-88Me), entertainment (like UbiSoft Entertainment's POD), and education (like DK Multimedia's Ultimate Human Body 2.0).

TRACKING THE PENTIUMS

The 200-MHz MMX Pentium sits atop Intel's lineup of desktop Pentium CPUs. Intel's new sixth-generation *Pentium II* CPU (formerly code-named Klamath) brings MMX, clock speeds up to 300 MHz, and a new single-edge contact (SEC) cartridge design.

The Pentium Pro, which debuted in 1995 as Intel's first sixth-generation CPU, does not inherently offer MMX technology. However, in 1998, Intel will have Pentium Pro OverDrive CPUs, with MMX and faster clock speeds. Both the Pentium II and the Pentium Pro are currently marketed as business CPUs, while Pentiums (especially MMX Pentiums) are marketed toward consumers.

REVIEW CRITERIA

We asked vendors to supply us with business-oriented PCs, each with a 200-MHz Pentium MMX CPU, 32MB of RAM, a

MMX is here, but is it here too early for business users? PC Labs tests 63 office-oriented 200-MHz MMX Pentium PCs to find out. By Robert S. Anthony

ture of MMX CPUs is their support of a process called *SIMD* (Single Instruction, Multiple Data). SIMD allows MMX CPUs to take a single calculation and perform it on more than one chunk of data at a time. Non-MMX Pentiums must perform calculations separately on each piece of data. MMX CPUs also have 32K of L1 cache, double the cache in non-MMX Pentiums.

MMX-enhanced CPUs perform best

hard disk with a minimum capacity of 2GB, a 6X or faster CD-ROM drive, and audio capabilities. The graphics card had to have 4MB of RAM, and the vendors had to provide 17-inch monitors. Most of what we received were simple variations of clone PCs. Only a handful came in cases designed with ease of servicing in mind.

If you think some of the machines here seem more like home than business PCs,

SERVICE EASE

Serviceability is key for a business PC. Here are our favorites.



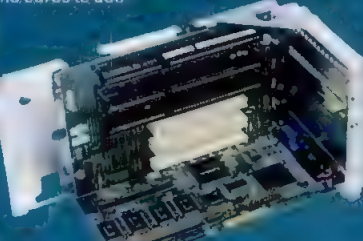
JUST FLIP the layers and pull, and Digital's motherboard slides out for easy service.



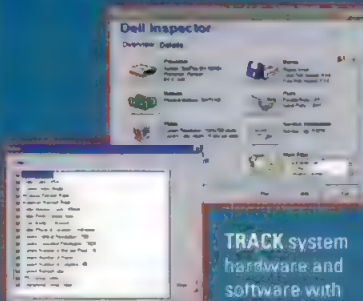
FAST ETHERNET integrated on the motherboard means no cards to add.



LOCK UP the Dell Optiplex to deter component theft.



THE REMOVABLE expansion card cage in the Optiplex makes adding boards a snap.



TRACK system hardware and software with Dell's Inspector.



FLIP OUT the Dell Optiplex's power supply for easy access to the motherboard.

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you're right. Some vendors bundled their units with software that is aimed more at the home than at the corporate market. While we believe audio support is an essential element of today's business PC, it need not be at the level of a home or game PC. Nevertheless, some vendors sent PCs with audio systems that would make a game maven drool. One unit—the Magna Media from Maximus Computers—even came with a television tuner. While this is an interesting feature, it might be a hard sell to an executive seeking to upgrade a fleet of office PCs.

HARDWARE HEAVEN

An interesting new piece of hardware is Intel's 430TX PCI chip set, which is designed to support MMX-enhanced CPUs. This chip set offers built-in support for the Universal Serial Bus

(USB), the Dynamic Power Management Architecture (DPMA), and the Ultra DMA (Direct Memory Access) protocol.

The combination of Ultra DMA and a hard disk with an Ultra ATA interface supports burst transfer rates of 33.3 MBps, twice the rate of the Fast ATA-2 interface. Today's Ultra ATA hard disks spin at a top speed of 5,400 rpm, which may not be fast enough to take advantage of the 33.3-Mbps transfer rate, but Ultra ATA disks do burst data from the drive buffer across the PCI bus faster, which reduces both PCI bus and EIDE bus utilization. These disks will also boost performance of some operations that benefit from being cached in the drive buffer. Faster-spinning Ultra

ATA drives are expected by year's end.

Of the 63 units here, only two, the Dell Dimension XPS M200s and the Millennia

MME P200 from Micron Electronics, combined the 430TX PCI chip set with an Ultra DMA-33 hard disk. However, the best performers here on our Business Disk WinMark 97 tests were those with 10,000-rpm Ultra Wide SCSI hard disks.

MICROSOFT'S NO-BYPASSING ZONE

Another interesting trend we found here was the use of graphics card drivers that bypass the Windows graphics device interface (GDI). By intercepting some graphics operations normally handled by the Windows GDI, graphics card can show marginal gains on some synthetic graphics benchmark tests. However, *PC Magazine* found that Windows GDI bypassing buys you nothing in real life.

Our Business Winstone 97 tests reflect real-world performance with business applications; we could detect no difference in performance between PCs with GDI bypassing turned on and those with bypassing turned off. You'll note in our benchmark test scores that we highlight cases in which a PC came to us with a graphics card with GDI bypassing turned on (we tested the machines as shipped to us by the vendors). In most cases you can simply go to the Windows 95 Control Panel or the graphics card's own driver and turn GDI bypassing off. Microsoft will not certify any PC that employs GDI bypassing as PC 97-compliant, because the company feels that bypassing causes system instability.

GETTING SERIOUS

The desktop version (ceramic or pin-grid array) of the 200-MHz Pentium with MMX Technology is \$539 in quantities of 1,000; a non-MMX 200-MHz Pentium is \$498. As this price gap closes, MMX will become no more unusual on a business PC than a PCI slot or a network card.

For now, MMX is more useful for shooting up bad guys than for crunching numbers. While there are some business tasks, such as videoconferencing, that could benefit from MMX, the business-PC buyer may have to wait to see the first killer MMX business apps. In the meantime, the chip's extra L1 cache will buy a slight performance gain. And if you're concerned with buying dated technology, the MMX Pentium is a good bet: From now on, Intel will not bring any new processor to market that doesn't have MMX.



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features information
for these 63 MMX
Pentium PCs.

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Editors' Choice

- Dell Dimension XPS M200s
- Dell Optiplex GXi 200
- HP Vectra XA 5/200



Gone are the days when a networked PC was an island. Today, that PC must be intelligent and manageable,

not to mention feature-rich and affordable. We found two systems in this roundup that were up to the task, plus one that's a great bang-for-the-buck choice if you don't need extensive management features.

If you want a PC that goes above and beyond the DMI call of duty, either the \$3,245 Dell Optiplex GXi 200 or the \$3,160 HP Vectra XA 5/200 will fill the bill. The Optiplex is jam-packed with features to make your network administrator's life easier, including integrated Fast Ethernet that supports TX and T4 wiring; an easy-to-service, lockable, tool-free chassis; and a SMART hard disk that will notify you of impending failure. Add Dell's Inspector and a 32-bit MIF browser for tracking system assets (which supports all features outlined

by the DMTF, as well as Optiplex-specific extensions) and you have an intelligent, manageable PC.

Our second Editors' Choice in the manageable category is Hewlett-Packard's HP Vectra XA 5/200. It features standard Fast Ethernet, a tool-free and lockable chassis, and software including McAfee's VirusScan and WebScan. But its most exciting feature is TopTools: HP's desktop management solution is easily the most complete and functional we've seen. TopTools' easy-to-navigate GUI interface lets you manage all DMI-specific attributes and dozens of other features specific to the Vectra.

Our third Editors' Choice is a great pick if you don't need extensive management features: the \$2,999 Dell Dimension XPS M200s. The Dimension takes a cue from its past Editors' Choice-winning siblings, providing a great deal of useful hardware at an attractive price. It features a massive 6.2GB Ultra DMA hard disk, a 33.6-Kbps modem, a Zip drive (complete with three 100MB cartridges), and Microsoft Office 97 Small Business Edition.

We were also very impressed with the Compaq Deskpro 5200X/4200/PDS, and we award it an honorable mention. The

Deskpro packs an incredible amount of hardware into its mini-tower case, including a capacious 4GB Ultra SCSI hard disk and a 650MB PD/CD drive. It is also among the elite in terms of management solutions, with Compaq's Enhanced Intelligent Manageability. However, at a price of \$5,040, it's expensive for a Pentium PC.



HP Vectra XA 5/200, Dimension XPS M200s, Optiplex GXi 200.

Aberdeen

Aberdeen P5-200MMX

The Aberdeen P5-200MMX (\$2,791 direct) is moderately priced unit with competitive performance, making it a good value for a mainstream business setting. Equipped with two USB ports for future peripherals and a CPU heat-level monitoring system with a warning buzzer, the Aberdeen system should prove to be a reliable network workstation.

As tested, the Intel HX chip set-based P5-200MMX had one IRQ and two DMA channels available. Two ISA slots couldn't take a full-length expansion board because of interference from the CPU's heat sink and fan. On our benchmark tests, the unit's CD-ROM WinMark 97 score was above average; all other scores were average.

A larger-than-average 4.8GB Maxtor ATA-3 hard disk, a 33.6-Kbps modem, and a Microsoft Natural Keyboard make the

Aberdeen an attractive package. The standard one-year warranty can be upgraded to include on-site service for \$109.95.

If you aren't seeking the highest performance levels but want a system that has reasonable expansion space and can be custom-configured with any peripherals you specify, Aberdeen's P5-200MMX is a good choice.—*Bruce Brown*

Aberdeen P5-200MMX. Direct price: \$2,791. Aberdeen, Santa Fe Springs, CA; 800-552-6868, 310-801-5626; fax, 310-801-5629; www.aberdeeninc.com. Circle 441 on reader service card.

ABS Computer Technology Inc.

ABS Corporate System

If you want an MMX PC but need to adhere to a tight budget, you may be interested in ABS Computer Technology's ABS Corporate System (\$1,995 direct). You get what you pay for, however: On our

benchmark tests this unit produced generally low-average or below-average scores.

One free IRQ address and two available DMA channels mean you should be able to add components without hassle. Two memory expansion slots are accessible, but getting to the four others means removing a drive—a simple tool-free operation using a single-clip closure. Both ISA slots can accommodate full-length cards, though the outermost slot requires that you bend the card slightly to get it inside the case.

Because the Corporate System had 256K of L2 cache as opposed to 512K, its benchmark-test scores were relatively low, particularly the CPUmark₃₂ score, which was one of the lowest in this roundup. The system's Matrox Mystique graphics card contributed to a below-average Business Graphics WinMark 97 score. The unit's Business Winstone 97 score was barely average.

Adding more L2 cache and a faster

DMI, TCO, COA: Not Just Acronyms Anymore

By Carol Venezia and S. Jae Yang

TCO, or *total cost of ownership*, is the most overused catchphrase of the year next to "show me the money." But if you're a vendor selling PCs to large businesses, it has likely become the bane of your existence. Why? Because your customers are reading studies telling them how much it costs to maintain a PC over its lifetime. And they want to know what you're going to do to lower the costs.

If you're buying PCs for a large business, the logical first step to lowering TCO is managing your company's PC assets from a central location. In order to do this, the PCs on your network must be manageable.

THE IMPORTANCE OF DMI

DMI, or the Desktop Management Interface, is a specification put forth by the Desktop Management Task Force (DMTF), which includes many industry leaders. The DMI spec is currently in Version 1.1.

DMI offers a way to inventory a system's components and settings without opening the PC. But it doesn't address the network administrator's need to manage the network from one location. DMI Version 2.0 (which should be finalized by this fall) will add remote-manageability specifications. Now, however, there are some vendors that have expanded on the DMI 1.1 spec to include remote-management capabilities for their PCs.

DESKTOP MANAGEMENT WHAT?

Of the 62 vendors in this roundup, less than half knew what we were talking about when asked if their PCs were

DMI-compliant. Of these, a few (including Comtrade and DirectWave) used ASUSek's new DMI-instrumented motherboard coupled with Intel's LANDesk Client. Toshiba takes the LANDesk approach but adds features of its own, including a chassis-intrusion alert. A few others mailed their "solution" to us: a hand-labeled BIOS configuration disk.

There were some, however, that went beyond the call of duty. Compaq, Dell (for the Optiplex), Digital, Hewlett-Packard, and IBM all provided 32-bit service layers and PC-specific browsers for managing assets beyond the features outlined by the DMTF.

We tested these PCs by hooking each to an OpenView server and polling each PC to see what information we could get. We could not test the DMI-compliant PCs from Acer and Gateway, because for a non-HP

TopTools, you can view system components and access detailed information specified by DMI 1.1. At the Open View console, you can remotely wake up the PC, update the BIOS, and detect system errors, to name just a few features.

We were also impressed by Dell's OptiPlex, loaded with a 32-bit service layer (that can interface with OpenView and Microsoft's SMS) and Dell's browser Inspector 3.1. By selecting Inspector's Overview tab, you can view system information; the Details tab shows supported DMI attributes. Under DMI 2.0, Dell will support industry-standard remote monitoring.

COMPAQ, DIGITAL, AND IBM

Compaq, Digital, and IBM also provide system-specific management tools for their PCs: Enhanced Intelligent Manageability, ClientWorks,

and NetFinity, respectively. All three provide 32-bit service layers, PC-specific browsers, and configuration utilities. All three expand on the DMI spec and also include features above and beyond those outlined as trackable by the DMTF.

THE BOTTOM LINE

When Intel starts to ship DMI-instrumented motherboards (expected by year's

end), it will be open season on DMI. Vendors that have been addressing the issues surrounding DMI all along will be poised to take advantage of this new management paradigm. In the meantime, if your current PC supplier either looks confused or hands over a floppy disk as a management solution, it may be time for you to shop around.

Glossary of DMI Terms

Component instrumentation The executable code that provides DMI management for a particular component

DMI browser A management application that lets you query a system for information on hardware and software components

Management interface (MI) The layer

Service layer (SL) The code instrumentation and management

Component interface (CI) The layer used by component instrumentation

DMI browser A management application that lets you query a system for information on hardware and software components

Management agent A management agent that connects to the DMI through the MI

Management application Code that manages the system components

MIF (management information file) A file used by

MIF database A database that stores MIF information in a specific format for each component

PC to be managed remotely via OpenView, the PC must have a 32-bit service layer. Acer and Gateway provided browsers but had 16-bit service layers.

HP LEADS THE PACK

The best DMI implementation here is on HP's Vectra, equipped with a 32-bit service layer, a 32-bit remote agent, and HP's new browser TopTools. Through

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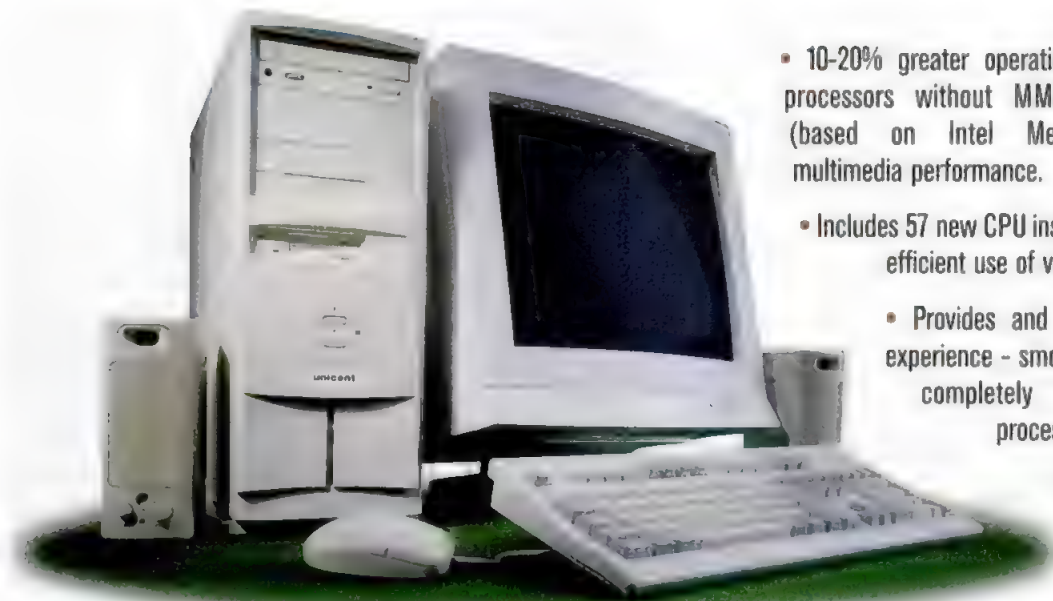
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To cut through the **confusion** of buying a new PC, we've handicapped the processors, disks, and other technologies that may **affect** your decision. This **information** applies whether you're looking at MMX Pentium PCs such as the 63 systems **reviewed** here or at PCs with other CPUs.

PC BUYERS' GUIDE

Four Pentium chip families are now on the market: the classic Pentium, Pentium MMX, Pentium Pro, and a newcomer, the Pentium II.

If you'd rather save cash than stay ahead of the technology curve, the **classic Pentium** may be the CPU for you (average system price about \$2,000).

The **Pentium MMX** is the chip of choice for consumer PCs (average system price \$2,500 to \$3,500). It's an **attractive CPU for the home** because software that exploits the MMX's 57 instructions for speeding multimedia tasks is already available. However, the chip's **extra L1 cache alone will buy some performance**. If you can spend a bit more than what you'd pay for a classic Pentium, we suggest MMX.

The **Pentium Pro** (average system price \$2,500 to \$3,000), once the x86 speed demon for 32-bit apps, has just been eclipsed by the Pentium II. The Pro is a **decent pick if you work in a fully 32-bit environment** and want to save some cash over what you'd pay for a Pentium II.

The **Pentium II** has just debuted as Intel's premier processor for the desktop (average system price \$4,000 to \$5,000 and up). Available at speeds of 233 or 266 MHz in single- or dual-processor configurations, this P6-class chip is a **good bet if you crave speed** and are **willing to pay for it**. It uses Intel's new Slot 1 SEC (single-edge contact) cartridge technology, which is likely to become the vendor's packaging of choice for future CPUs.

AMD's just-released **K6** has already made history: It's the first processor to pose a **serious challenge to Intel's high end**. The K6 comes in speeds up to 233 MHz and includes MMX. If AMD's pricing plans play out, K6 chips will be about 25 percent cheaper than like-speed Pentium IIs.

DMI DOMINATES. If you want your corporate PCs to be manageable, DMI is a must. But **DMI 1.1 is a spec in flux**. It lacks remote-management capabilities and support from component manufacturers.

Once DMI 2.0 is finalized, it will include specs for re-

mote manageability. Version 2.0 is also waiting for a 32-bit service layer. Without it, you can't do much more over a network than inventory the hardware inside the box. If you want to **get serious work done** from a management console or remote site, **you need that 32-bit service layer**.

For now, **large systems vendors have a head start**. Most have written their own 32-bit service layers and browsers. Because their PCs have this service layer, they are remotely manageable now (though to access many of the DMI extensions the vendors write into their software, you must use their supporting software on the server). These vendors are well positioned to leapfrog the competition that, by year end, will have access to DMI 2.0-instrumented motherboards, 32-bit service layers, and software management solutions. In other words, **shrink-wrapped DMI** is right around the corner.

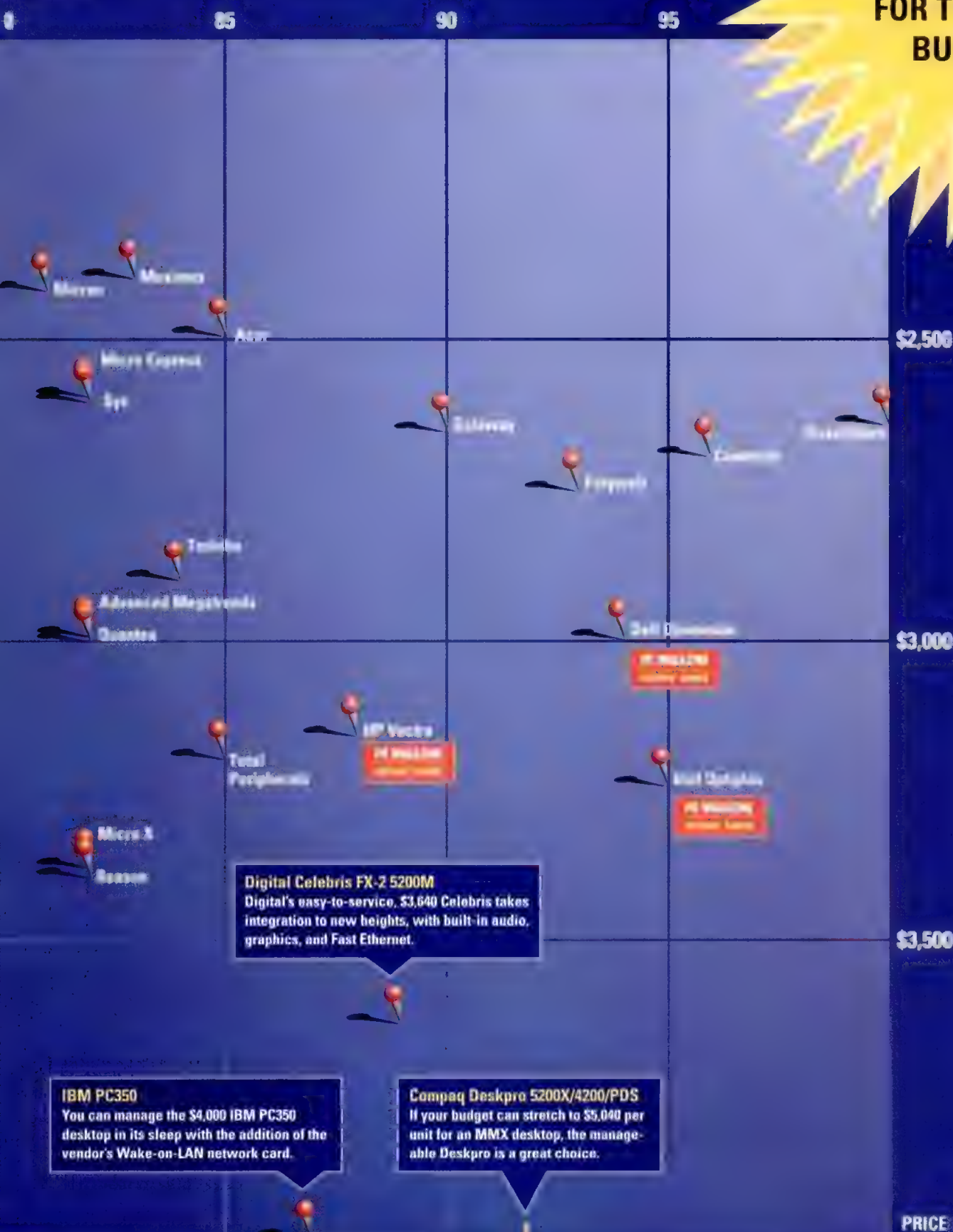
HURRY UP AND WAIT. Universal Serial Bus (USB) architecture is talked about endlessly but isn't really here yet. Yes, Microsoft has released a version of Windows 95 that supports USB (OSR 2, which is sold to systems vendors only—you can't get it unless you buy a **new PC**); and more PCs have USB connectors. But the peripherals have been slow to follow.

DISK DELIRIUM. Basically, disk technology boils down to either Enhanced IDE (EIDE) or SCSI. On the **EIDE** side, disks up to about 6.5GB are available; they're **cheaper than SCSI** and relatively easy to install.

For top speed and capacity, **SCSI** is the way to go. SCSI drives are more expensive than EIDE; they also are louder, run hotter, and **may cause signaling issues at high speeds** if other devices such as CD-ROM or tape drives are attached to the same cable. But SCSI drive capacities now reach 9GB and beyond and are available at rotational speeds up to 10,000 rpm. If you're running huge databases or imaging files, Ultra Wide SCSI is for you. If you're running spreadsheets and word processors, we suggest EIDE.

Just coming out as we went to press are **Ultra DMA** drives: If you've got the right core-logic chip set (Intel's 430TX), they support 33-MBps burst-mode transfers.





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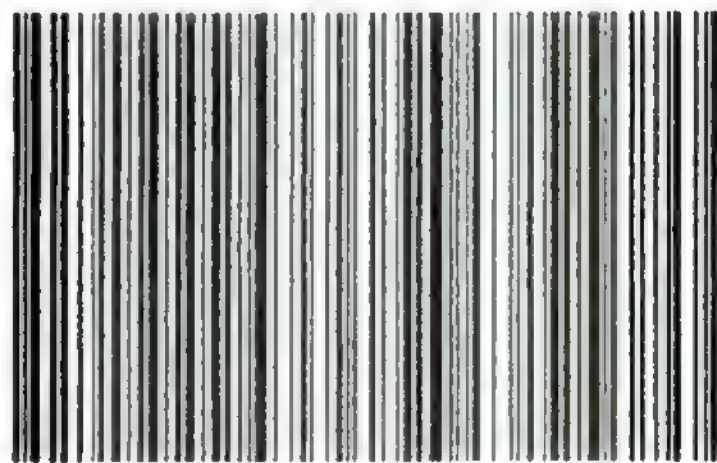
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Desktop PCs: Price, Performance, and Features

PERFORMANCE /
FEATURES

65

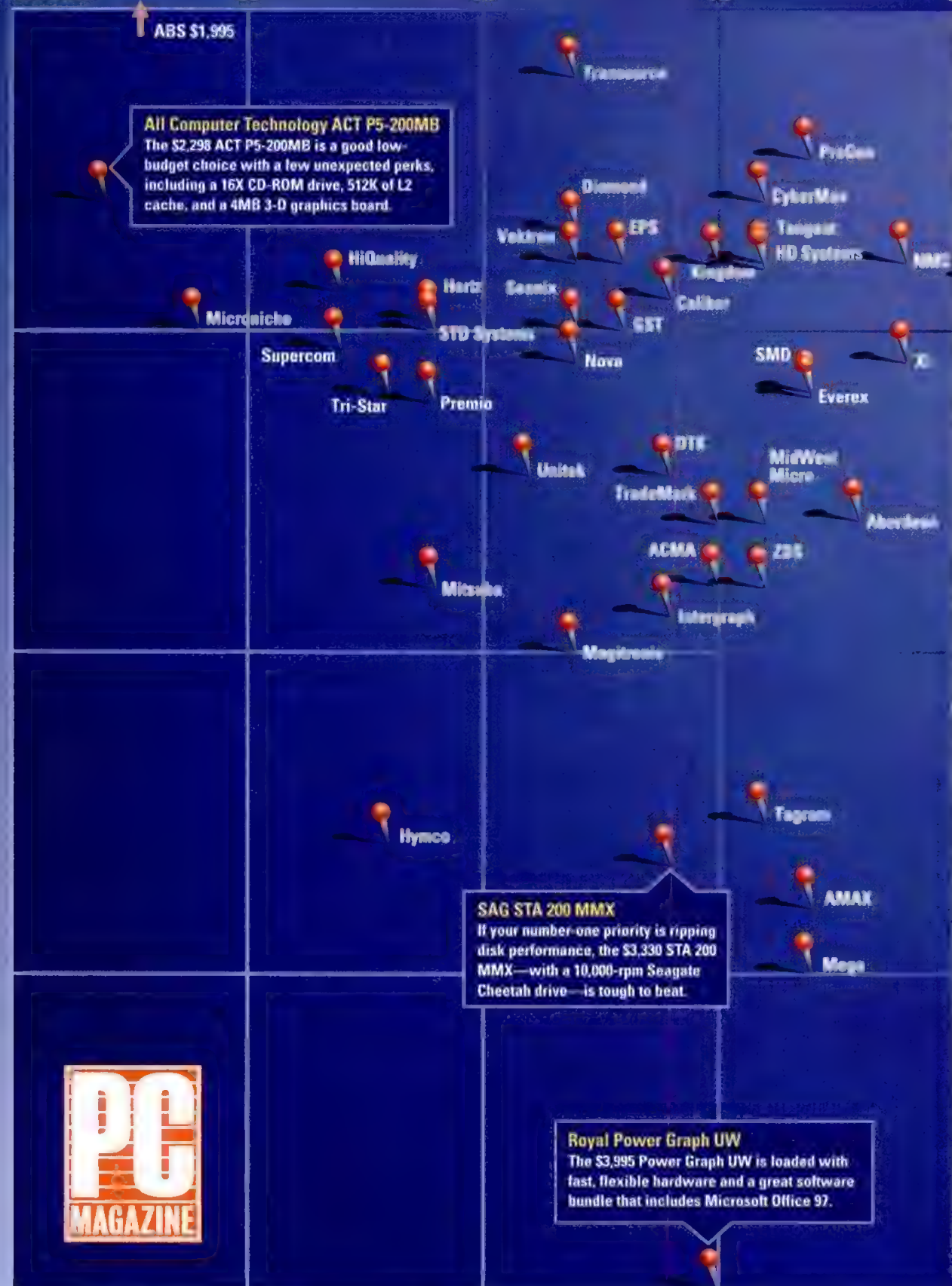
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ABS \$1,995

All Computer Technology ACT P5-200MB

The \$2,298 ACT P5-200MB is a good low-budget choice with a few unexpected perks, including a 16X CD-ROM drive, 512K of L2 cache, and a 4MB 3-D graphics board.



SAG STA 200 MMX

If your number-one priority is ripping disk performance, the \$3,330 STA 200 MMX—with a 10,000-rpm Seagate Cheetah drive—is tough to beat.

Royal Power Graph UW

The \$3,995 Power Graph UW is loaded with fast, flexible hardware and a great software bundle that includes Microsoft Office 97.

MMX Pentium PCs

The good news is that if you want a capable, well-equipped MMX Pentium machine, chances are you won't have to break the bank to get it: Most of the systems in this roundup were priced less than \$3,000. The great news is that in most cases, the PC you'll be getting for that price is well equipped to tackle today's standard business apps, and then some.

The \$2,999 Dell Dimension XPS M200s, one of our Editors' Choices in this roundup, is a case in point. This PC boasts a 6.2GB Fast ATA-3 hard disk, Microsoft Office 97 Small Business Edition, a Zip drive with three 100MB cartridges, and a 33.6-Kbps modem. It was a strong performer on our benchmark tests, with especially good results on our Business Disk WinMark 97 tests. To sweeten the deal, Dell provides an attractive warranty: three years on parts and labor, with a year of on-site service.

If you're in a **networked environment** where manageability is a chief concern, you needn't worry. The Dell Optiplex GXi 200 and Hewlett-Packard Vectra XA 5/200—also Editors' Choices—both provide all the power and management tools you need for \$3,245 and \$3,160, respectively. Each is fully DMI-compliant, has a tool-free, lockable chassis, and ships with Fast Ethernet. Each also features its own management software: Dell's Inspector or HP's TopTools. Both are easy to use and track all DMI assets as well as additional features. Both also offer SMART hard disks (which alert you in advance of failure), and HP bundles McAfee's VirusScan and WebScan as well. Both systems were good performers and come with three-year warranties and one year of on-site service.

Two systems here also offer an appealing mix of management features with strong hardware packages. The \$2,649 DirectWave MVP X-200 and Comtrade's \$2,695 Lightning PC are both DMI-compliant and come with Intel's LANDesk Client Manager. Both use DMI-instrumented motherboards by ASUStek, which feature on-board logic to monitor system status, including temperature, voltage, and fan speed. These features, along with a DMI-enabled BIOS and LANDesk, allow you to monitor the health of these PCs over the network.

The DirectWave unit also features a 4.8GB ATA-3 hard disk, Intel's 430TX chip set, synchronous DRAM, and a Diamond Stealth 3D 3000 graphics card. The system earned above-average Business Disk and Business Graphics WinMark 97 scores and has a three-year warranty with one year of on-site service. The Comtrade system also offers Intel's 430TX chip set and SDRAM. This unit adds an Intel EtherExpress PRO/100B Fast Ethernet card and a 33.6-Kbps modem. It uses S3's new VIRGE/GX graphics chip set along with IBM's 3GB hard disk; together, these components helped yield above-average Business Disk and Business Graphics WinMark 97 scores. Lotus SmartSuite 96 is also bundled with the system.

If you're working with a tight budget, you might want to take a look at this roundup's most inexpensive system, the \$1,995 ABS Corporate System. Its graphics performance was low and its Business Winstone 97 score was within the average range, but it will get the job done. It

comes equipped with a 2GB Western Digital hard disk and a Matrox Mystique graphics card. The system also features a good warranty: three years on parts and lifetime coverage on labor.

Conversely, if you have no budgetary constraints, you may want to consider Compaq's \$5,040 Deskpro 5200X/4200/PDS. Through its Enhanced Intelligent Manageability, the unit provides all the network management tools found on the Optiplex and the Vectra, including a prefailure warranty on the hard disk. Compaq further sweetens the deal with a 4GB Ultra SCSI SMART hard disk and a PD/CD drive that can provide 650MB of optical storage or function as a 6X CD-ROM drive. If the system receives an imminent failure warning on the hard disk, the PD/CD drive will switch from CD mode into PD mode to back up critical data onto the optical drive (you can also opt to back up to your network).—*Analysis written by Anush Yegyzarian*

The Data Points

When we conduct the price/performance index for each PC, the features that make up the performance/features score will vary.

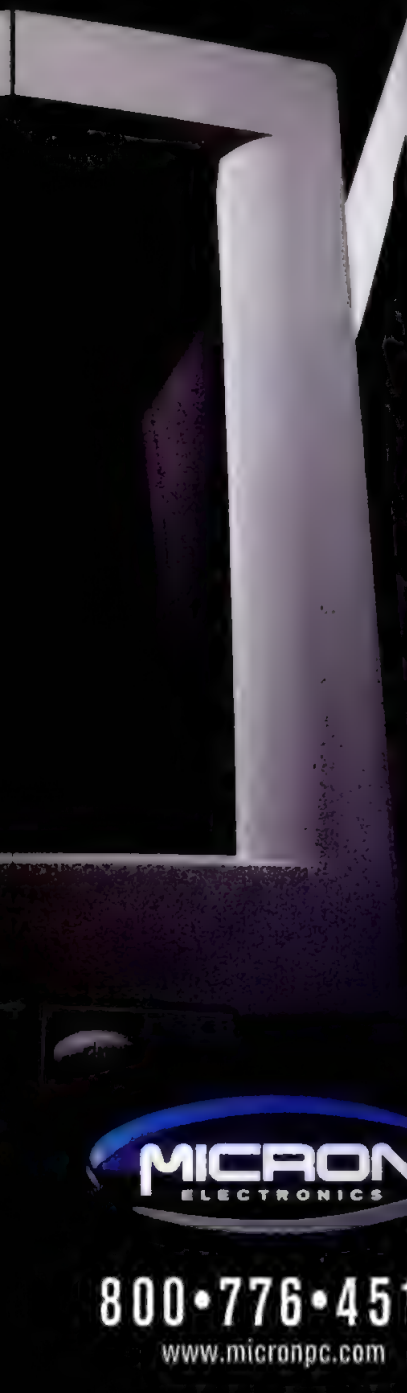
Both a system's features and its benchmark test scores are considered and given various weightings to create the final score. The ZD Business Winstone 97 tests represent overall system performance in a general 32-bit business environment; it was given a weight of 30 percent. CD-ROM performance accounts for another 4 percent. The monitor's viewable diagonal size and the size of the hard disk account for 10 percent. The warranty on parts and labor, on-site service, and technical-support options account for 12.5 percent.

The DMI standard developed by the Desktop Management Task Force facilitates network management. The protocol sets up a bi-directional path through which administrators can interrogate the software and hardware on a PC (if you want to work on the system remotely, as by flashing the BIOS or updating drivers, a PC must be equipped with a 32-bit service layer). Since networks are ubiquitous and network management a common concern, we verified full DMI compliance and weighted it at 10 percent.

Network cards, modem speed, and free IRQs account for 15 percent of the score. Available expansion room and a tool-free chassis make up another 7 percent. The remaining portion of the score is based on the presence of serial, mouse, and USB ports, as well as the presence of a flash BIOS and the type of FAT disk partition (FAT16 or FAT32) used in the system, among other features.

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Shopper Best Buy of 1996 for Best High-End Desktop PC Micron Millennium P200 Plus • January 1997,

PC Magazine Best Products of the Year Micron Millennium P133 • January 1997,

PC Magazine Best Products of the Year Micron Millennium P166 • January 1997, **PC World**

Top 20 Power Desktops #1 Micron Millennium P166 • January 1997, **PC World**

Top 20 Power Desktops #4 Micron Millennium Pro200 Plus

• January 1997, **PC World** Top 20 Budget

Desktops #1 Micron Millennium P133

• February 1997, **PC World** Top 20 Power

Desktops #4 Micron Millennium Pro2 200

• February 1997, **PC World** Top 20 Budget

Desktops #2 Micron Millennium P133

• February 1997, **PC Magazine** Editor's

Choice Award Micron Millennium Mx: P200

• February 1997, **PC World** Top 20

Power Desktops #4 Micron Millennium

Pro2 200 • February 1997, **PC World**

Top 20 Budget Desktops #2

Micron Millennium P133 • February 1997,

Family PC Top Rated/Best Buy

Micron Millennium Mx: P200 • February

1997, **Computer Life** Best of

Everything 5 star rating Micron

Millennia Mx: P166 • March 1997, **PC**

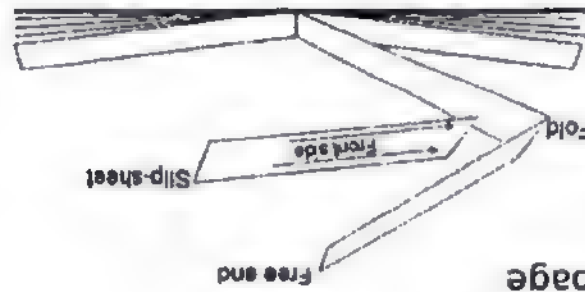
World Top 20 Power Desktops #4

Micron Millennium Pro2 200 • March 1997,

PC World Top 20 Budget Desktops #2

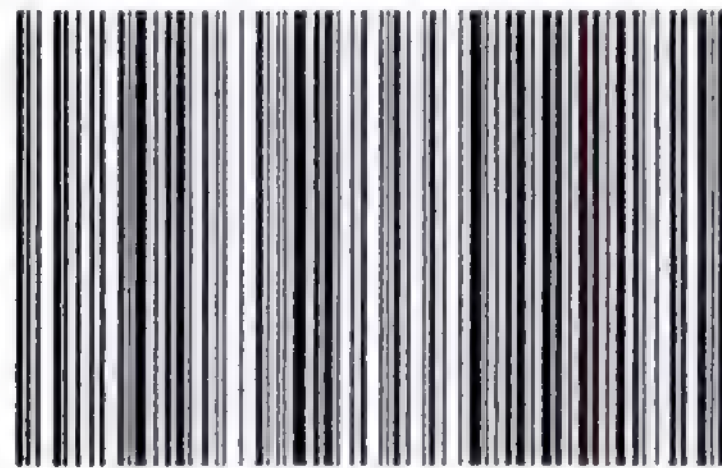
Micron Millennium P133





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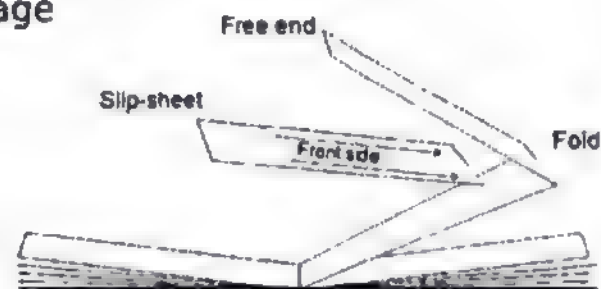


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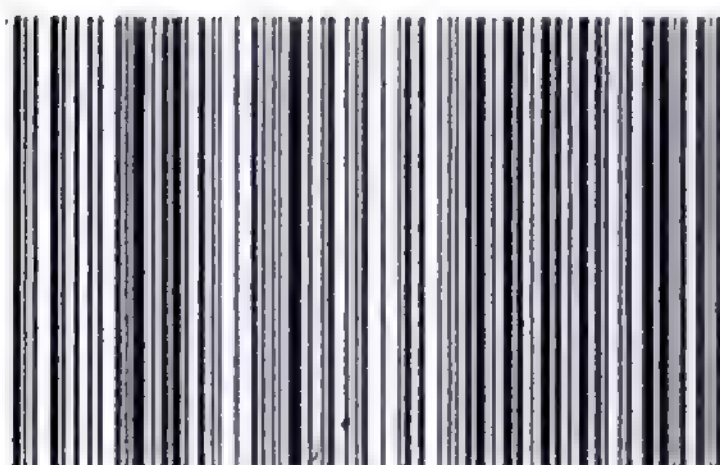
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12X SCSI CD-ROM drive
3.5" floppy drive
100MB Iomega Zip drive

32 voice wavetable stereo sound with speakers
56Kbps technology modem*
PCI 64-bit 3D video, MPEG, 4MB EDO RAM
Tool-free minitower or desktop
Microsoft Intellimouse, 104-key keyboard

Microsoft Windows 95 and MS Plus! CD
Microsoft Office 97 SBE CDs
Multimedia Xcitement Pak
(comprised of MMX technology-based software)
2 USB connectors
5-year/3-year Micron Power limited warranty

Intel 200MHz Pentium processor
with MMX
32MB SDRAM
4GB SCSI hard drive
17" Micron 17FGx, .28dp
(15.8" display)

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MICRON MILLENNIA 1460 PC

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3.5" floppy drive
16-bit stereo sound and speakers

PCI 64-bit 3D video, MPEG, 2MB EDO RAM
Tool-free minitower or desktop
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Microsoft Windows 95 and MS Plus! CD
Microsoft Works CD
5-year/3-year Micron Power limited warranty

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100MB Iomega Zip drive
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PCI 64-bit 3D video, MPEG, 4MB EDO RAM
Tool-free minitower or desktop

Microsoft Mouse, 104-key keyboard
Microsoft Windows 95 and MS Plus! CD
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graphics board would boost this machine's performance considerably, but the price would go up as well.—BB

ABS Corporate System. Direct price: \$1,995. ABS Computer Technology Inc., City of Industry, CA; 800-876-8088; fax, 818-937-2322; www.abscomputer.com. *Circle 442 on reader service card.*

Acer America Corp.

AcerPower 9536WM

Acer America Corp.'s AcerPower 9536WM (\$2,500 street), an attractive corporate system, combines a reasonable price, a better-than-average warranty, and good expansion capability. A slow hard disk dragged down performance, however.

The DMI-compliant AcerPower comes with Intel's LANdesk Client Manager as well as a browser, the Acer Desktop Manager. This browser is easy to use but doesn't provide nearly as much system information as its competitors (such as HP's TopTools or Compaq's Enhanced Intelligent Manageability) do. The unit has two free IRQs and two free DMAs, which make adding peripherals easier. Lotus SmartSuite and McAfee AntiVirus are also bundled.

The unit's motherboard, based on an Intel HX chip set, features 512K of L2 cache. Its 4MB SGRAM STB Nitro 3D graphics adapter helped it earn an above-average Business Graphics WinMark 97 score. The 3GB 4,500-rpm Quantum Fireball hard disk, however, held the AcerPower back on the Business Disk WinMark 97 tests. Other scores were average.

Inquire about a faster hard disk if you want a speedier corporate system, but otherwise this unit is a good choice for

general business applications.—BB

AcerPower 9536WM. Street price: \$2,500. Acer America Corp., San Jose, CA; 800-733-2237, 408-432-6200; fax, 408-922-2933; www.acer.com/aac. *Circle 443 on reader service card.*

ACMA Computers Inc.

ACMA EXP200

ACMA Computers' ACMA EXP200 (\$2,895 direct) is a relatively good buy that offers midrange performance, good warranty coverage, and a complete set of peripherals, including a 3GB hard disk.

You get two unoccupied drive bays, five free DMAs, nine available IRQs, easy access to memory slots, and three ISA slots capable of holding full-length cards, all of which makes the ACMA system easy to build up. The EXP200's Altec Lansing speakers, 28.8/14.4-Kbps modem (which will be upgraded to a 33.6/14.4-Kbps model by the time you read this), and 16X Sony

warranty and on-site service for the first year, coverage is fine, though the Pacific-time tech-support hours may seem limited.

The ACMA EXP200's features should place it in the middle of the business-system radar screen.—BB

ACMA EXP200. Direct price: \$2,895. ACMA Computers Inc., Fremont, CA; 800-786-6888, 510-623-1212; fax, 510-623-0818; www.acma.com. *Circle 444 on reader service card.*

Advanced Megatrends Microsystems Inc.

Apollo 200M5

The Apollo 200M5 (\$2,995 direct) is a well-designed ATX midtower complete with a Fast Ethernet card. With this unit, Advanced Megatrends Microsystems offers the latest in Pentium-platform technologies in a tidy, easily serviceable layout.

The Apollo's case stacks three drives (CD-ROM, floppy, hard disk) and four drive bays in an orderly column. Ample

space between the bays and other components allows easy installation of additional drives. All cables are neatly tethered.

The unit's motherboard, based on Intel's new 430TX chip set, has two DIMM slots and four SIMM slots. A Creative Labs audio card, a 28.8/14.4-Kbps data/fax modem, and an Fast Ethernet card also come with the unit. The vendor bundles the Apollo with Microsoft Office 97 Professional Edition,

Perfect Media's mic-A-phone (which includes VocalTec's Internet Phone software and a stand-up microphone), and QuickLink Message Center software. Performance was average across our tests.

New technology, good performance, and great software place the Apollo among the more appealing units in this roundup.—Cade Metz

Apollo 200M5. Direct price: \$2,995. Advanced Megatrends Microsystems Inc., West Warwick, RI; 800-495-2955, 401-737-3776; fax, 401-737-3862; www.advancedmegatrends.com. *Circle 446 on reader service card.*



ACMA EXP200, Apollo 200M5.

CD-ROM drive add to the PC's value.

An Intel HX chip set-based motherboard with 512K of L2 cache in combination with the machine's 4MB STB Velocity 3D graphics adapter and Quantum Fireball 3GB hard disk helped the system gain average scores across our benchmark tests.

With a three-year-parts, one-year-labor

Our Contributors: ROBERT S. ANTHONY is a senior writer at *PC Magazine*. CADE METZ is a staff writer, MARY E. BEHR is a staff editor, and JOSHUA LEVY is an editorial researcher at *PC Magazine*. BRUCE BROWN and ALFRED POOR are contributing editors, and FRANCIS J. EVANS is a freelance writer for *PC Magazine*. MARGARET PIEMONTE is a technical analyst at PC Labs. CAROL VENEZIA was the senior editor in charge of this story, and S. JAE YANG was the project leader.

BENCHMARK TESTS

Pentium MMX Business PCs



The Pentium Processor with MMX Technology is not the only new component that makes today's mainstream business PCs go fast. We found that the recipe for success includes Intel's new 430TX PCIset, 512K of secondary cache, synchronous DRAM, an Ultra ATA or Ultra SCSI hard disk, and a 64-bit graphics accelerator card.

▲ Higher scores represent better performance.
▼ Lower scores represent better performance.
Bold type denotes first place.
Italic type denotes a system using a graphics driver that bypasses GDI.

	ZD Business Winstone 97 Score	ZD Business Graphics WinMark 97 Score	ZD Business Disk WinMark 97 Thousands of bytes per second	ZD CPUmark32 Score
Aberdeen P5-200MMX	43	89	956	412
ABS Corporate System	41	81	862	365
AcerPower 9536WM	41	79	782	414
ACMA EXP200	41	74	805	414
Advanced Megatrends Apollo 200M5	43	76	901	416
All Computer Technology ACT P5-200MB	42	64	939	413
AMAX PowerStation Biz5000X	41	74	868	425
Caliber Voyager V MMX	44	62	839	406
Compaq Deskpro 5200X/420Q/PDS	46	64	1,110	398
Comtrade Lightning PC	44	79	1,150	429
CyberMax Max i6-P200MMX	42	77	1,100	414
Dall Dimension XPS M200s	41	67	1,100	404
Dell Optiplex GXi 200	42	80	860	401
Diamond DT-200MMX-CPC	46	75	847	411
Digital Celebris FX-2 5200M	45	67	994	377
DirectWave MVP X-200	43	79	999	428
DTK Quin-55M/PM200	43	76	887	394
EPS Evolution EV-3 200 MMX	42	77	836	412
Everex Step Premier	42	64	867	411
Gateway P5-200 Professional	44	68	776	419
GST/Micro City Aspegos 9000PT	42	79	1,210	424
HD Victoria Platinum 200MMX	43	66	860	380
Hertz P200e	43	64	860	410
Hewlett-Packard Vectra XA 5/200	43	79	849	411
HiQuality HIQ-ECW-200	42	78	889	408
Hymco HWS-5200MX	42	67	1,020	383
IBM PC350	43	74	932	398
Intergraph TD-25	41	79	899	414
Kingdom Pentium MMX 200 Value	41	71	825	406
Magitronic G-P200MX	41	67	918	372
Maximus Magna Media	44	57	991	404
Mega Impact Pentium/MMX200	43	80	1,000	406
	BETTER ►	BETTER ►	BETTER ►	BETTER ►

(1) With an Action, Indeo, 160-by-120, 30-fps, 300-KBps clip

(2) With an Action, Cinepak, 640-by-480, 30-fps, 900-KBps clip

What the Numbers Mean

Intel's 200-MHz Pentium Processor with MMX Technology is the theme of this roundup, but the real story is in the supporting hardware that distinguished the winners from the losers in this group of 63 business-oriented PCs. In our last MMX Pentium roundup (in our issue of February 4, 1997), we explored the capabilities of MMX Technology. We saw an instant 10 to 20 percent improvement in running popular 32-bit business applications and a significant boost in executing software coded with MMX instructions. When the playing field was leveled by setting the processor constant, however, the players that brought new

weapons to the field rose to the top.

One component that affected performance in this roundup was the Intel 430TX PCIset. Almost one-third of the units in the roundup were fitted with this chip set, which, like its predecessor, the 430VX, supports synchronous DRAM. Synchronous DRAM played a minor role in increasing performance on our benchmark tests. Also among the chip set's performance-enhancing features is support for the Ultra DMA protocol, which empowers Ultra ATA hard disks to move data across the bus at up to 33.3 MBps. Still, because of faster rotational speeds, Ultra SCSI is the speed demon of the mass-storage world. In addition to the 430TX, we

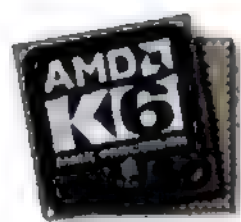
CD-ROM				Full-Screen Scaling ¹		High-Quality Action Cinepak ²	
ZD CD-ROM WinMark 97 Thousands of bytes per second	Sequential 16K Read (thousands of bytes per second) ▲	Access Time (ms) ▼	CPU Utilization (percent) ▼	Frames dropped ▼	CPU Utilization (percent) ▼	Frames dropped ▼	CPU Utilization (percent) ▼
1,200	1,790	106	4	1	23	137	95
939	1,540	167	40	107	98	284	49
1,030	1,810	134	79	1	23	10	88
1,150	1,560	118	37	1	21	10	90
1,130	1,820	126	46	1	18	4	90
1,100	1,370	98	36	139	98	53	95
1,160	1,550	118	39	1	19	1	85
996	1,800	145	79	0	30	93	94
586	919	210	43	107	98	318	98
1,150	1,820	126	48	1	17	1	71
1,140	1,820	120	30	39	98	124	97
1,030	1,820	138	46	77	98	38	96
706	1,220	161	31	81	98	211	97
870	1,220	150	31	1	26	21	94
1,120	1,810	125	79	1	33	235	97
1,120	1,800	130	48	1	27	89	95
1,130	1,830	129	43	1	24	0	79
1,040	1,820	134	45	1	24	0	79
741	1,210	158	30	0	27	5	90
941	1,970	170	52	0	97	0	97
1,100	1,350	98	61	1	95	11	90
1,130	1,860	126	80	98	97	215	95
1,140	1,830	126	46	99	99	20	95
818	1,240	147	6	9	97	6	85
1,120	1,490	126	41	1	92	0	81
795	1,210	179	7	81	98	0	91
1,100	1,360	96	34	1	20	13	89
1,130	1,830	126	79	87	99	163	95
1,110	1,470	115	66	0	28	17	92
1,020	1,470	119	41	1	27	147	97
1,060	1,470	147	37	1	19	1	83
1,100	1,360	100	62	3	96	59	92

BETTER ►

Continues

Don't buy these three letters.

MMX



Are all MMX chips created equal? Hardly. The AMD-K6™ MMX processor is clearly superior. Versus any Pentium, the K6 chip is faster. It's smaller, packing the power of 8.8 million transistors onto the smallest 6th-generation die. It runs cooler. It's easier to use because it's Socket 7 compatible. And it costs less. As an MMX processor, it delivers a new

generation of multimedia performance. In short, the AMD-K6 MMX processor is the most awesome engine ever built for running Microsoft Windows®-based PCs. Use one and it will leave you with this three-letter reaction: Wow. See for yourself and visit our website for the latest performance benchmarks or call 1-800-222-9323.

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BENCHMARK TESTS

also found that most of our Business Winstone 97 champs were loaded with the Matrox Millennium graphics accelerators.

We witnessed some new trends as well. All but three systems came with Microsoft Windows 95 OEM Service Pack Release 2 (OSR2) installed. Key features of OSR2 include USB support, ActiveMovie, and the option of formatting your hard disk with FAT32 instead of FAT16. ActiveMovie is a new media-control architecture that effectively replaces the archaic MCI. Though FAT32 makes much more efficient use of a disk's clusters and space, we saw no conclusive relationship between drive performance and the FAT format. Our tests have also uncovered surprisingly disappointing results with the latest so-called "16X" CD-ROM drives.

ZD Business Winstone 97 Business Winstone 97 is a "reality test" program that allows no excuses and invalidates all unfounded claims. The tests profile a system's performance by executing a script composed of a set of the most popular business applications. The tests yield a score in each of three categories (database, publishing, and spreadsheet/word processing) and ultimately produce a number that indicates the tested system's likely performance in a real-world setting.

The three top-scoring machines on our Winstone tests were Polywell, Reason, and Tagram—yielding almost indistinguishable results. Four of the top six Winstone performers used the 430TX PCIset; on the average, TX-equipped systems posted Winstone scores that were about 5 percent better than machines with other

▲ Higher scores represent better performance.
▼ Lower scores represent better performance.
Bold type denotes first place.
Italic type denotes system using a graphics driver that bypasses GDI.

	ZD Business Winstone 97 Score	ZD Business Graphics WinMark 97 Score	ZD Business Disk WinMark 97 Thousands of bytes per second	ZD CPUmark32 Score
Micro Express MicroFlex-MMX/200	45	73	1,210	415
Micron Millennia MME P200	46	100	1,050	416
Microniche MIS-55PM	41	65	834	345
Micro X MXP-5000	44	70	1,020	428
MidWest Micro MWO-200-X Office PC	40	50	1,010	398
Mitsuba Premier System-200MMX	43	72	1,000	410
NMC Expert+MMX200	43	75	879	412
Nova P55-200MMX	41	66	840	414
Polywell Poly 5200Tx8	47	70	1,270	425
Premio TX-P200M	39	56	1,000	395
ProGen Atlas X-200	43	81	888	406
Quantex QP5/200 SM-3X	43	64	1,060	412
Reason Square One HQ/M-200	47	78	1,480	424
Royal Power Graph UW	45	73	1,440	411
SAG STA 200 MMX	45	76	1,450	418
Seenix CS Plus 200	41	64	864	425
STD Compupartner MMX5-200	39	61	764	425
Summit Micro Design Mount Shasta MMX	44	78	987	420
Supercom Touch MMX200-210	41	76	820	411
Sys Performance P200T2M	44	82	940	421
Tagram Thunderbolt MXL 200	47	88	1,480	420
Tangent 5200M	44	73	958	419
Toshiba Equium 5200D	41	55	972	383
Total Peripherals Archer-2000	45	70	1,130	419
TradeMark TM200MMX	43	72	947	411
Transource-MTX200	41	63	849	382
Tri-Star Tri-CAD IA5 MMX	38	47	857	395
Unitak UT-P200MMX Trojan	44	75	975	404
Vektron Home Office 200M	41	50	828	381
Xi MX200 MTower	44	74	983	407
ZDS Performance 200x	42	73	832	413

BETTER ►

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(1) With an Action, Indeo, 160-by-120, 30-fps, 300-Kbps clip

(2) With an Action, Cinepak, 640-by-480, 30-fps, 900-Kbps clip

chip sets. SDRAM also made an impact: 5 of the top 11 Winstone performers packed this type of memory. On the average, SDRAM boosts Winstone performance by about 3 percent compared with EDO DRAM. For storage, 7 of the top 11 used SCSI devices. Though graphics performance is less of an issue in Winstone, the Matrox Millennium and cards with S3's ViRGE chip set populate the top-ranking systems.

The machine in this roundup that produced the one of the lowest scores on our Winstone tests was STD's Compupartner MMX5-200. The major contributing factor to this system's poor performance was its 5,200-rpm hard disk. Although this spin rate is not terribly slow for a mainstream Pentium PC, it is definitely slower than the average presented in this roundup. The majority of EIDE-based

machines here used 5,400-rpm devices, and many used extremely fast, 7,200-rpm SCSI devices. Compupartner's disk is certainly acceptable for general-purpose business applications but unfortunately was left in the wake of faster disks on the benchmark tests.

2D Business Graphics WinMark 97 Scores on our Business Graphics WinMark 97 tests can be attributed mainly to the graphics card's chip set, memory, RAMDAC, and driver, as well as to the system's memory and bus architecture. The elite group of graphically proficient systems we looked at for this roundup featured Matrox Millennium or Diamond Stealth 3D 2000 or 3000 cards with variations of S3's ViRGE chip set. Machines with either ATI's 3D Rage II graphics chip set or the Matrox Mystique card

CD-ROM				Full-Screen Scaling ¹		High-Quality Action Cinepak ²	
2D CD-ROM WinMark 97 Thousands of bytes per second	Sequential 16K Read (thousands of bytes per second) ▲	Access Time (ms) ▼	CPU Utilization (percent) ▼	Frames dropped ▼	CPU Utilization (percent) ▼	Frames dropped ▼	CPU Utilization (percent) ▼
1,090	1,830	121	9	1	15	1	75
1,050	1,350	93	18	0	25	0	94
715	1,200	185	58	104	98	271	96
1,090	1,460	133	66	85	98	126	95
1,010	1,960	144	89	1	23	23	90
1,130	1,840	128	46	1	20	17	90
971	1,350	161	36	103	98	19	94
1,150	1,830	126	48	1	28	19	95
1,110	1,490	120	19	74	98	0	82
1,030	1,800	132	79	1	22	5	86
1,160	1,560	114	39	0	97	0	97
1,140	1,790	126	60	91	99	269	97
1,120	1,460	122	7	1	21	1	80
1,240	1,680	106	9	1	15	1	69
1,140	1,820	127	43	1	31	1	89
1,050	1,960	147	52	91	98	14	88
1,120	1,500	125	40	0	27	8	92
1,030	1,800	131	48	1	92	0	81
1,030	1,960	145	52	1	26	1	90
997	1,830	172	43	1	26	3	85
1,250	1,670	104	8	74	98	6	82
1,130	1,820	129	46	1	20	15	89
1,130	1,800	133	44	1	19	3	76
1,090	1,280	103	60	78	98	157	95
978	1,820	176	79	1	25	86	94
993	1,790	174	44	103	98	10	95
1,040	1,780	132	44	1	21	24	91
1,010	1,790	134	78	1	31	232	96
1,100	1,460	120	36	0	17	105	98
1,070	1,470	134	38	1	28	44	94
1,130	1,820	128	11	1	20	0	80

BETTER ►

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posted the lowest scores on these tests.

The lowest score on our Graphics WinMark tests was posted by Tri-Star Computer Corp.'s Tri-CAD IA5 MMX. Using an STB Velocity 3D graphics accelerator card powered by S3's ViRGE/VX chip set and 4MB of dual-ported EDO VRAM, the system turned in a score on the Graphics WinMark tests that was less than half that of the top-scoring machine. This was even more surprising given that the card's driver was bypassing GDI. The STB Velocity 3D is a very adept graphics accelerator, providing support for numerous 3-D and advanced graphics-related functions, which include flat and Gouraud shading, bilinear and trilinear texture filtering, perspective correction, and MIP mapping, as well as fogging and depth cueing. It also supports Microsoft's Direct3D and OpenGL.

We suspect that the culprit behind this low score is an older version of the graphics card's driver. This test result points out a very important factor: It pays to make regular visits to the Web site of the vendor whose graphics board your PC uses so you can keep abreast of new driver releases and download them as necessary. This will ensure that your graphics accelerator is always operating in top form.

Though the Graphics WinMark score is indicative of a PC's ability to render graphically intensive software, the tests do not necessarily project performance in running less visually demanding business applications. For instance, the Polywell PC tied for the best Winstone score despite its merely average Graphics WinMark score.

Clearly, the correlation between graphics subsystem performance and overall system performance is not so pronounced, but that didn't discourage many system vendors from buying into the intensely competitive spirit within the graphics card industry. This was apparent as 54 percent of the systems (34 out of 63 machines) reviewed here used graphics drivers that were rigged to bypass the standard but antiquated Microsoft graphics device interface (GDI), which limits certain graphics activities to mostly 16-bit operations. Note that in the test charts, scores of those PCs whose graphics drivers employed GDI bypassing are indicated by italic type.

Our subjective testing showed that for most systems, GDI bypassing nets a meager 1 to 4 percent improvement on our Graphics WinMark tests. One exception is Micron's Millennia, the only system using a Diamond Stealth 3D 2000 graphics board with S3's new ViRGE/DX chip set. With GDI bypassing disabled, Micron's number-one Graphics WinMark score of 100 dropped 15 percent to 85. Such inflation of scores failed to show us any measurable real-world benefits since none of the systems, including Micron's, registered any gain in Business Winstone due to GDI bypassing. For details on GDI bypassing, visit PC Magazine Online (www.pcmag.com) and follow the links to the PC Labs page.

ZD Disk WinMark 97 While most of the electronics inside PCs operate in time frames measured in nanoseconds, the hard disk is still primarily a mechanical device that ticks by milliseconds, posing a major limiting factor in system performance. Consequently, any gain in disk speed means significant improvement in system performance.

The 430TX chip set promises performance enhancement for ATA hard disks that support the Ultra DMA protocol. Ultra DMA allows up to 33.3-MBps burst-mode throughput rates over the Ultra ATA interface and through the PCI bus to memory. In the near future, once drives with faster rotational speeds are available (the current limit is 5,400 rpm), Ultra ATA drives should rival Ultra SCSI.

We saw two Ultra ATA disks here: a Quantum Stratus in

Micron's PC and an IBM Deskstar DHEA-36480 in Dell's Dimension. These units performed on a par with the slowest of the Ultra SCSI-equipped machines. However, Ultra ATA disks are still no match for the 10,000-rpm Ultra Wide SCSI Seagate Cheetah disks found in the top Disk WinMark scorers from Reason, Royal, SAG, and Tagram.

ZD CPUmark₃₂ With no variation in processors here, CPUmark₃₂ becomes mainly a test of chip set, L2 cache, and memory. The winning combination proved to be the Comtrade Lightning PC, a system with the 430TX chip set, SDRAM, and 512K of L2 cache. The extra L2 cache alone resulted in a 10 percent jump in CPUmark₃₂ scores, on the average. Such improvement translates to a 2 percent boost in the overall system performance as measured by Winstone 97.

CD-ROM WinMark 97 With this test suite, we go beyond the "X rating" and seek the score that reflects the CD-ROM's performance in real life, where the reading of data is not always done sequentially. Our test results show little correlation with the X rating. In fact, we found that the latest so-called 16X drives do not live up to their moniker at all. This surprising discovery warranted further research at PC Labs (see "Inside PC Labs" in this issue for details).—*Analysis written by S. Jae Yang and Margaret Piemonte*

How We Tested

We tested all systems with 2GB hard disks or larger, 8X CD-ROM drives or faster, and 32MB of RAM. We used each vendor's pre-installed graphics driver for 1,024-by-768 resolution with 16-bit color, small fonts, and a refresh rate as close to 75 Hz as possible. We also disabled power management features and removed unnecessary drivers. We defragmented hard disks before each test run and let Windows 95 manage virtual memory settings.

We used our benchmark test program ZD Winstone 97, Version 1.0, to measure the machines' performance when running 32-bit Windows 95 applications. Winstone 97 is divided into two categories: ZD Business Winstone 97, focusing on mainstream applications, and ZD High-End Winstone 97, which emphasizes CPU and graphics-intensive applications. In this roundup, we ran only our **ZD Business Winstone 97** tests, which measure the time a PC takes to execute a set of application scripts that exercise eight of the best-selling Windows 95 applications. Business Winstone weights a given PC's test timings based on the applications' unit market shares; it derives a composite number and converts it to a relative score. (The score is relative to the performance of a Gateway 486DX2/66 with 16MB of RAM, whose score is defined as 10.)

ZD WinBench 97, Version 1.1, measures graphics, disk, processor, CD-ROM, and motion-video performance under Windows 95. Version 1.1 incorporates updates to Disk WinMark 97 and the video tests. Disk WinMark 97 was updated to address Microsoft's changes to the buffer flush routines in OSR2. The video tests now utilize the new ActiveMovie media control architecture, which Microsoft populated through OSR2 and Microsoft Internet Explorer 3.0. Like our Winstone test program, ZD Graphics WinMark 97 and ZD Disk WinMark 97 are each divided into Business and High-End sections. In this roundup, we ran only the Business portions of these suites.

The **ZD Business Graphics WinMark 97** score, a number based on a log of GDI operations used in the Business Winstone 97, repre-

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sents the performance of each machine's graphics subsystem under Windows 95. Scores are normalized to reflect performance relative to the base system used for Business Winstone testing. The **ZD Business Disk WinMark 97** score, based on a log of disk functions used in the Business Winstone suite, represents the performance of each machine's disk subsystem under Windows 95. Results are reported in thousands of bytes per second and then converted to a harmonic mean weighted in the same way as the Business Winstone results.

The **ZD CPUmark₃₂** score reflects the speed of a PC's processor subsystem—which includes the CPU, secondary cache, and system RAM—under a 32-bit operating system. The CPUmark test suite emulates the CPU activity of real-world applications.

The **ZD CD-ROM WinMark 97** test suite gauges the performance of each machine's CD-ROM subsystem, which includes the CD-ROM drive, its adapter, and its required software drivers. The test suite is based on a profile of six of today's most popular Windows CD-ROMs. We report the results of the **CD-ROM Sequential 16K Read** test, which measures the throughput of a CD-ROM subsys-

tem as it reads 16K blocks of data on a CD-ROM. The **CD-ROM Access Time** test measures CD-ROM drive performance as it randomly accesses 2K blocks from the entire CD-ROM. The **CD-ROM CPU Utilization** score represents the percentage of the CPU's bandwidth occupied by servicing the CD-ROM subsystem as it retrieves data. To determine the amount of utilization, WinBench 97 uses a default block size of 16K. The transfer rate defaults to the maximum rate of the particular CD-ROM subsystem. WinBench 97 then calculates this transfer rate before it runs the actual test.

WinBench 97 also includes a suite of video tests that measure a PC's ability to play full motion .AVI files. We test video-playback performance with two types of clips at a variety of data and frame rates, using either an Indeo or Cinepak codec. We report results from the **Full-Screen Scaling** test, which uses an Action Indeo, 160-by-120, 30-frame-per-second, 300-Kbps clip, and the **High-Quality Action Cinepak** test, which uses a Cinepak, 640-by-480, 30-fps, 900-Kbps video clip. For both sets of tests, we report **Frames Dropped** and **CPU Utilization**.

All Computer Technology

ACT P5-200MB

All Computer Technology's ACT P5-200MB (\$2,298 direct) has a lower-than-average price, but not at the expense of performance scores; it even includes a 16X CD-ROM drive. Ample expansion room makes it an attractive option for companies that want to step up to the MMX level without breaking the bank.

Using an Intel VX chip set and 512K of L2 cache, the ACT posted average scores on most benchmark tests. It gave up a little performance, however, with the respectable but less competitive Matrox Mystique 3D graphics adapter with 4MB SGRAM, which was behind the unit's below-average Business Graphics WinMark 97 score.

Memory expansion slots are easily accessible. Of the two ISA slots that can take full-length cards, only one was free in the test system, but one IRQ, two DMA channels, and four drive bays were available, so upgrades should be painless.

The ACT won't set performance records unless you select a hotter graphics adapter, but for the money this system provides a good combination of features, performance, and expandability.—*BB*
ACT P5-200MB. Direct price: \$2,298. All Computer Technology, City of Industry, CA; 800-775-1953, 818-369-4181; fax, 961-7462; www.allcomp.com/acw. *Circle 445 on reader service card.*

AMAX Engineering Corp.

PowerStation Biz5000X

Any computer called *PowerStation* had better live up to its name. AMAX Engineering Corp.'s PowerStation Biz5000X (\$3,400 street) does, with competitive performance on our benchmark tests, plenty of room for expansion, and a Fast Ethernet adapter that makes it ready to plug into your network. This is one tower you'll be happy to make room for.

Even with its Intel EtherExpress PRO/100B Fast Ethernet adapter, this tower has six empty drive bays, two free DMA channels, and one free IRQ. A U.S. Robotics 33.6-Kbps modem and some Microsoft software titles, including Microsoft Office 97 Professional Edition, are bundled.

The PowerStation's 3GB Quantum Fireball hard disk posted an average score on the Business Disk WinMark 97 tests, while its 16X Sony CD-ROM drive was responsible for an above-average result on the CD-ROM WinMark 97 test. Other test scores were average for this group.

The PowerStation offers respectable serviceability, expandability, components, and performance. It's higher-priced than many here but has the hardware and software to back the price up.—*BB*
PowerStation Biz5000X. Street price: \$3,400. AMAX Engineering Corp., Fremont, CA; 800-800-6328, 510-651-8886; fax, 510-651-4119; www.amax.com. *Circle 447 on reader service card.*

Caliber Computer Corp.

Voyager V MMX

Direct vendor Caliber Computer Corp.'s Voyager V MMX (\$2,449 direct) has an appealing price and includes all the basic components you'll need in a new PC. Adding new components, however, could be a hassle.

Four empty drive bays and three ISA slots for full-length cards are pluses, but when we installed a network card there were no available IRQs for configuring new devices. Four DMA channels are free. Memory expansion slots are located under the power supply, which isn't terrible but makes adding RAM less than convenient.

On our benchmark tests, the Voyager posted a below-average Graphics WinMark 97 score and a low-average Disk WinMark 97 score. Both results contributed to a Business Winstone 97 score that just cracked the average range.

In addition to an unusually blurry 17-inch Sceptre monitor, there are several MMX edutainment titles bundled with the system—but this is hardly an IS department requirement. A 33.6/14.4-Kbps modem does add value, however.

If you need a basic, no-frills PC at a reasonable price, Caliber's Voyager V MMX might fill the bill.—*BB*
Voyager V MMX. Direct price: \$2,449. Caliber Computer Corp., Fremont, CA; 510-353-1220; fax, 510-354-2134; www.calibercorp.com. *Circle 448 on reader service card.*

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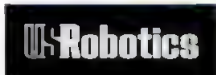
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x2 upgradable PC Card and step up when you're ready. Either way, we'll provide you with a convenient upgrade to future 56Kbps ITU industry standards. It's just what you'd expect from U.S. Robotics®—the company known for solid connections and a complete line of information access products.



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Compaq Computer Corp.

Deskpro 5200X/4200/PDS

It's easy to chase low-priced PCs or look at numbers to find the highest-scoring one. For businesses, however, where price and top test numbers don't rule decisions, Compaq Computer's Deskpro 5200X/4200/PDS (\$5,040 street) may be ideal. It is designed to run reliably, protect data, and simplify maintenance, though some buyers may balk at its price.

This PC boasts great serviceability as well as Compaq Computer Corp.'s Enhanced Intelligent Manageability, a set of hardware and software features to help administrators keep track of assets. Its features include an integrated 10Base-T Ethernet controller, a case sensor that alerts administrators to unauthorized access, thermal overload detection and notification, and a surge-tolerant power supply. The system also includes a 6X PD/CD drive. It functions both as a 6X CD-ROM drive and a 650MB rewritable optical drive.

You'll have to balance the Deskpro's many MIS-friendly features against its price—the highest in this roundup.—*BB*
Deskpro 5200X/4200/PDS. Street price: \$5,040. Compaq Computer Corp., Houston; 800-345-1518; fax, 281-518-1442; www.compaq.com.

Comtrade

The Lightning PC

Aggressively priced, The Lightning PC (\$2,695 direct) comes with a full set of hardware components for network and telecommunications. Using the latest Intel TX chip set, the DMI-compliant speedster was a strong test performer.

Four open drive bays, good memory slot access, three full-length ISA slots, two free IRQs, and two available DMA channels make the system ripe for expansion, and Intel's LANdesk software takes full advantage of the ASUStek motherboard's DMI capabilities. The unit also has an Intel

EtherExpress PRO/100B Fast Ethernet card and a 33.6-Kbps modem. Bundled software includes Lotus SmartSuite 96.

An IBM 3GB hard disk, an STB Nitro 3D graphics card with 4MB EDO DRAM, and the newest S3 ViRGE/GX chip set powered the Lightning to high levels on the Business Disk and Graphics WinMark 97 tests. Its 512K L2 cache and TX chip set helped it grab an average CPUmark₃₂ score. The Business Winstone 97 score was also average.

The Lightning PC is a clear winner for a direct-channel PC. High performance, low price, and easy, ample expansion are an unbeatable combination.—*BB*

The Lightning PC. Direct price: \$2,300. Comtrade, City of Industry, CA. 800-969-2123, 818-961-6688; fax, 818-369-1479; www.comtrade-pc.com. Circle 450 on reader service card.

CyberMax Computer Inc.

Max I6-P200MMX

Equipped with two USB connectors and a good mix of useful hardware and software, CyberMax Computer's Max I6-P200MMX (\$2,299 direct) is an appealing, low-priced PC.

The SiS motherboard, 512K L2 cache, a fast Seagate 2.4GB hard disk, and a Diamond Stealth 3D 3000 graphics adapter with 4MB VRAM combine to produce average scores, with one highlight: an above-average Disk WinMark 97 score.

Other notable components include wavetable audio with Altec Lansing ACS45 speakers and a 33.6/14.4-Kbps modem. One IRQ and two DMA chan-

nels were available in our test unit. Businesses will find the bundled Core! WordPerfect Suite 7 useful; other titles included a variety of home reference, educational, and entertainment packages.

After the purchase of 25 systems, corporate buyers can become CyberMax Gold Account customers, which provides businesses with priority 800 support numbers and next-day parts delivery.

With good performance, a low price, and respectable service and support policies, the Max I6-P200MMX is worth consideration.—*BB*

Max I6-P200MMX. Direct price: \$2,299. CyberMax Computer Inc., Allentown, PA; 800-443-9868, 610-770-1808; fax, 800-599-7576; www.cybmax.com. Circle 451 on reader service card.

Dell Computer Corp.

Dimension XPS M200s, Optiplex GXi 200

Direct vendor Dell Computer Corp. serves up two winning systems for business users: the Optiplex GXi 200 desktop (\$3,245 direct) and the Dimension XPS M200s minitower (\$2,999 direct). Both are Editors' Choices in this roundup. The Optiplex, designed for large networked installations, keeps stability of platform and total cost of ownership in mind, while the Dimension's cutting-edge features are aimed at the small business user.

Both Dells are very simple to service, featuring tool-free and easy-to-access enclosures. The Optiplex's expansion slots are on a riser card that easily lifts out of the unit. Although they use different types of memory—the Optiplex has four EDO DIMM slots, while the Dimension has two SDRAM DIMM sockets—both afford easy serviceability. And both have two USB connectors.

The Optiplex has an integrated 3Com 3C905TX 10/100-Mbps Fast Ethernet controller, which works with either TX or T4 wiring. We experi-



Dell Dimension XPS M200s, Dell Optiplex GXi 200.

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* The Micron TransPort Vlx comes with a 5-year/1-year limited warranty.



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MICRON HOME MPC

Award-winning Pentium® processor-based technology, an outstanding selection of software and competitive pricing make this a welcome addition to any family.

STANDARD FEATURES

512KB pipeline burst cache, flash BIOS
3.5" floppy drive
100MB Iomega Zip drive
32 voice wavetable stereo sound with speakers
Advent AV270 2x25 watt stereo speakers
in P200 only
33.6 fax/modem, speakerphone, voice mail
Microsoft® Phone telephony software

Internet ready: SPRYNET Internet trial membership, Microsoft Internet Explorer™ membership, America Online and CompuServe trial memberships
PCI 64-bit 3D video, MPEG, 2MB EDO RAM
Tool-free minitower or desktop
Microsoft Mouse, 104-key keyboard
Microsoft Windows® 95 and MS® Plus! CD
Microsoft Works CD

SystemSoft SystemWizard application for automated problem resolution
Quicken Financial Pak: Quicken Deluxe, Quicken Financial Planner, Quicken Parents' Guide to Money, Quicken Family Lawyer
Family Pak: ABCs by Dr. Seuss, Thinkin' Things Collection 1, Earthworm Jim and Mechwarrior 2
Microsoft Home Pak
5-year/3-year Micron Power™ limited warranty

HOME MPC P166

Intel 166MHz Pentium processor
16MB EDO RAM
2.1GB EIDE hard drive
12X EIDE CD-ROM drive
15" Micron 15FGx, 28dp (13.7" display)

\$1,599

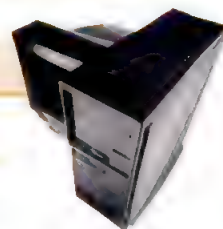
With Intel 200MHz Pentium processor with MMX™ technology add \$300
With Intel 166MHz Pentium processor with MMX subtract \$100

HOME MPC P200

Intel 200MHz Pentium processor
32MB EDO RAM
3.1GB EIDE hard drive
16X EIDE variable speed CD-ROM drive
17" Micron 17FGx, 26dp (15.8" display)

\$2,249

With Intel 200MHz Pentium processor with MMX add \$100
With Intel 166MHz Pentium processor with MMX subtract \$100



MICRON POWERDIGM

This new intel-based workstation punches through the most daunting 32-bit applications.

STANDARD FEATURES

256KB internal L2 cache, flash BIOS
12X SCSI CD-ROM drive
3.5" floppy drive
PCI 32-bit Ultra Wide SCSI-3 controller
Iomega Jaz SCSI drive with 1GB removable cartridge

32 voice wavetable stereo sound with speakers
Number Nine Imagine 128 series II video card, 4MB VRAM
3Com® 3C905 Fast EtherLinkXL 10/100 PCI TPO network adapter

Tool-free minitower
Microsoft Intellimouse, 104-key keyboard
Microsoft Windows NT® Workstation
5-year/3-year Micron Power™ limited warranty

MICRON POWERDIGM XL

Dual Intel 200MHz Pentium Pro processors
64MB ECC EDO RAM
4GB Ultra Wide SCSI-3 hard drive Bus. lease \$173/mo.
19" Hitachi SuperScan CM751, 26dp color monitor (18" display)

\$5,499



OPTIONS

MULTIMEDIA OPTIONS

32 voice wavetable stereo sound card \$59¹
32 voice wavetable stereo sound card with 2MB RAM \$99¹
Advent AV270 Powered Partners stereo speakers \$79
Advent AV370 Powered Partners stereo speakers with subwoofer \$199
Microsoft SideWinder™ 3D Pro joystick \$59
Microsoft SideWinder gamepad \$39

STORAGE/MEDIA OPTIONS

Adaptec 2940U Ultra SCSI Fast-20 controller \$100
(upgrade from system with standard Ultra SCSI Fast-20 controller)
Plextor 12Plex 12X 1.8MBps SCSI internal CD-ROM drive \$200²
(upgrade from systems with standard 12X EIDE CD-ROM drive)
Iomega Jaz SCSI drive with 1GB removable cartridge \$399³
Iomega ZIP IDE drive with 100MB removable cartridge \$99
Iomega 6-pack of 100MB Zip cartridges \$99
Iomega Ditto 2000 (1/2GB) Travan tape backup drive with tape \$149
Iomega Ditto 3200 (1.6/3.2GB) Travan tape backup drive with tape \$199
Sony 4/8GB SCSI DDS-2 tape backup drive with tape \$749⁴
Seagate Backup Exec Mylex dual channel Ultra SCSI-3 RAID caching controller with 4MB RAM \$249
\$899

NETWORKING OPTIONS

3Com 3C509B EtherLink III ISA combo network adapter \$79
3Com 3C900 EtherLinkXL PCI combo network adapter \$99
3Com 3C905 Fast EtherLinkXL 10/100 PCI TPO network adapter \$99
3Com OfficeConnect Hub 8/TPC \$149
3Com OfficeConnect Switch 140 \$969

COMMUNICATION OPTIONS

33.6 internal data/fax modem \$139⁵
33.6 internal data/fax modem, speakerphone, voice mail \$159⁴
33.6 external data/fax modem \$299

HP PRINTERS

HP DeskJet 692c printer \$329
HP LaserJet 5L-FS printer \$419
HP DeskJet 870 Cxi printer \$509
HP LaserJet 6P printer \$799

Price includes cable. Additional DeskJet/LaserJet models available. Please call for details.

SOFTWARE OPTIONS

EdVenture Pak: Sheila Rae the Brave, Putt-Putt Saves the Zoo, Reader Rabbit's Reading Development Library 1, Freddy Fish and the Case of the Missing Kelp Seeds, and the Thinkin' Things Collection 2 \$69
(available only on desktop and notebook systems with Microsoft Windows 95 and CD-ROM)
Quicken Financial Pak: Quicken Deluxe, Quicken Financial Planner, Quicken Parents' Guide to Money, Quicken Family Lawyer \$69
(available only on desktop and notebook systems with Microsoft Windows 95 and CD-ROM)

DISPLAY/VIDEO OPTIONS

17" Hitachi SuperScan 1711 (15.9" display) 26dp color monitor \$150¹
21" Hitachi SuperScan CM801 (20" display) 26dp color monitor \$650¹
Number Nine Imagine 128 series II video card, 4MB VRAM \$299¹
Number Nine Imagine 128 series II video card, 8MB VRAM \$549⁴

EXTENDED DESKTOP SERVICE OPTIONS

Optional 1st year on-site service⁶ coverage included
2nd year on-site service⁶ coverage (with system purchase) \$79
2nd year on-site service⁶ coverage (after system shipment) \$99
2nd and 3rd year on-site service⁶ coverage (with system purchase) \$99
2nd and 3rd year on-site service⁶ coverage (after system shipment) \$139

DIGITAL CAMERAS

Kodak Digital Science DC20 camera \$199
Kodak Digital Science DC25 camera \$499
Kodak Digital Science DC50 zoom camera \$699

OTHER OPTIONS

APC Per7T surge suppressor \$39
APC Pro7T surge suppressor \$59
APC Smart-UPS 700 with PowerChute plus software \$389
APC Smart-UPS 1000 with PowerChute plus software \$529
Microsoft Natural Keyboard® \$49
(upgrade from standard keyboard)



¹ Upgrade from systems with standard 16-bit stereo sound card
² Requires SCSI host adapter
³ Modern includes trial memberships to CompuServe and America Online
⁴ Modern includes trial memberships to CompuServe and America Online, requires sound card
⁵ Upgrade from systems with standard Micron 17" 17FGx color monitor
⁶ Upgrade from systems with standard 64-bit 2MB video card
⁷ 1st year on-site service is available in the United States and in limited areas in Canada from third-party service provider per customer's agreement with provider
⁸ 2nd year and 3rd year offerings are available in the United States only

Some options and accessories available with system purchase only

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Only the hottest, most current technology goes into the system that's right for you.

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THE MILLENNIA™ MME.

The Millennium MME rockets desktop performance to a whole new world of computing power with an Intel 200MHz Pentium™ processor with MMX™ technology, Intel's TX chip set and SDRAM.

Speed and productivity are enhanced as never before.

No compromises here.

This remarkable machine also puts on an awesome



display of multimedia power with a 3D video adapter, MPEG and wavetable sound. Want more good news? The Millennium MME is designed to make upgrades a snap. So what starts out as a superior PC can stay that way.

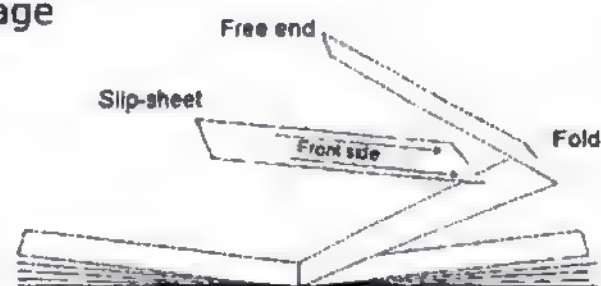
PENTIUM® PROCESSOR WITH MMX™ TECHNOLOGY. EXPANDING THE WORLD OF MULTIMEDIA.

All the great things the Intel Pentium processor does for performance, the Pentium processor with MMX technology does better. Modern operations.

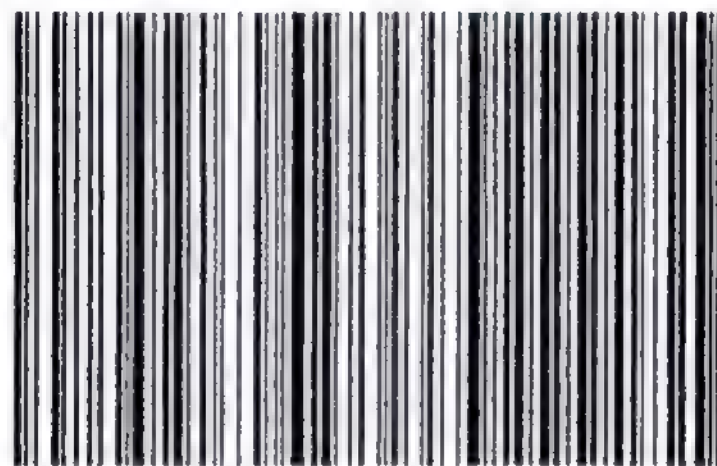
2D and 3D graphics. Video. Audio. The Internet. Memory. Video conferencing and whiteboard collaboration. MMX technology gives the entire system a boost in performance like never before.



1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Foldout slip-sheet

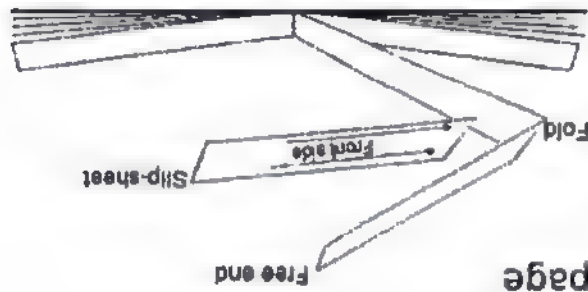


GbsSlipSheet-001

Inverted Foldout slip-sheet

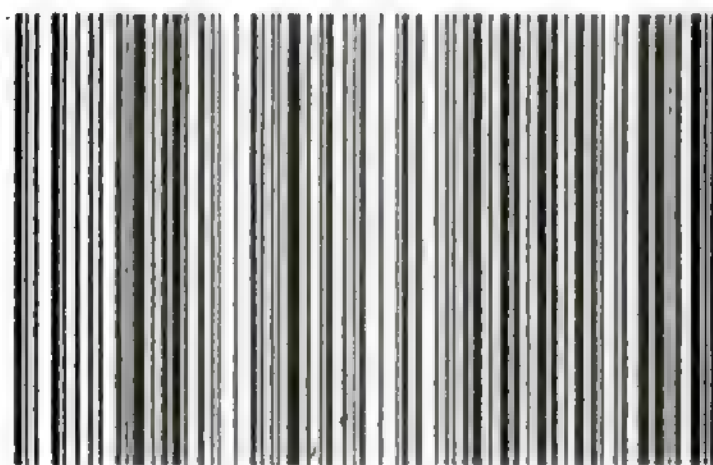
Folded edge of the page

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



1. Follow instructions on the other side

Inverted Back



Gbs5lipBack-0018

Back

1. Follow instructions on the other side

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In a world where big-name performance, reliability and service are slipping, our customers and industry experts have voted to honor Micron with over 100 awards. And that's just in the past two years.

You see, we're committed to delivering computers that perform better and run trouble-free longer than any other. And if support is ever needed, we're there to make things right for you, anytime of the day or night. Finally, your Micron PC comes backed by our industry-leading Micron Power™ warranty. It all makes for very strong computers. And very satisfied customers. You have our word on that. Call today.

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PERFORMANCE RULES WITH MICRON.[™]

MICRON MILLENNIA[™]

The Millennium family offers you an enlightening combination of performance and features to suit any budget.

MICRON MILLENNIA 1000 P200

STANDARD FEATURES

512KB pipeline burst cache, flash BIOS
16X EIDE variable speed CD-ROM drive
3.5" floppy drive
100MB Iomega Zip drive
32 voice wavetable stereo sound with speakers

56Kbps technology modem*
PCI 64-bit 3D video, MPEG, 4MB EDO RAM
Tool-free minitower or desktop
Microsoft[®] Intellimouse, 104-key keyboard
Microsoft Windows[®] 95 and MS[®] Plus! CD

Microsoft Office 97 SBE CDs
Multimedia Xcitement Pak
(comprised of MMX technology-based software)
2 USB connectors
5-year/3-year Micron Power[™] limited warranty

Intel 200MHz Pentium[®] processor with MMX[™] technology
16MB SDRAM
21GB EIDE hard drive
15" Micron 15FGx, .28dp (13.7" display)

\$1,959
Bus. lease \$67/mo.

Intel 200MHz Pentium processor with MMX
32MB SDRAM
31GB EIDE hard drive
17" Micron 17FGx, .26dp (15.8" display)

\$2,399
Bus. lease \$82/mo.

Intel 200MHz Pentium processor with MMX
64MB SDRAM
4GB EIDE hard drive
17" Micron 17FGx, .26dp (15.8" display)

\$2,659
Bus. lease \$91/mo.

MICRON MILLENNIA 1000 P100

STANDARD FEATURES

512KB pipeline burst cache, flash BIOS
PCI 32-bit Ultra SCSI Fast-20 controller
12X SCSI CD-ROM drive
3.5" floppy drive
100MB Iomega Zip drive

32 voice wavetable stereo sound with speakers
56Kbps technology modem*
PCI 64-bit 3D video, MPEG, 4MB EDO RAM
Tool-free minitower or desktop
Microsoft Intellimouse, 104-key keyboard

Microsoft Windows 95 and MS Plus! CD
Microsoft Office 97 SBE CDs
Multimedia Xcitement Pak
(comprised of MMX technology-based software)
2 USB connectors
5-year/3-year Micron Power[™] limited warranty

Intel 200MHz Pentium processor with MMX
32MB SDRAM
4GB SCSI hard drive
17" Micron 17FGx, .26dp (15.8" display)

\$3,159
Bus. lease \$108/mo.

MICRON MILLENNIA PRO2 200

STANDARD FEATURES

Supports dual Intel 200MHz Pentium Pro processors
256KB internal L2 cache, flash BIOS
16X EIDE variable speed CD-ROM drive
3.5" floppy drive

100MB Iomega Zip drive
16-bit stereo sound and speakers
PCI 64-bit 3D video, MPEG, 4MB EDO RAM
Tool-free minitower or desktop

Microsoft Intellimouse, 104-key keyboard
Microsoft Windows 95 and MS Plus! CD
Microsoft Office 97 SBE CDs
5-year/3-year Micron Power[™] limited warranty

Intel 200MHz Pentium Pro processor
32MB EDO RAM
31GB EIDE hard drive
56Kbps technology modem*
15" Micron 15FGx, .28dp (13.7" display)

\$2,299
Bus. lease \$78/mo.

Intel 200MHz Pentium Pro processor
64MB EDO RAM
4GB EIDE hard drive
17" Micron 17FGx, .26dp (15.8" display)

\$2,799
Bus. lease \$96/mo.

Intel 200MHz Pentium Pro processor
64MB EDO RAM
4GB SCSI hard drive
12X SCSI CD-ROM drive
PCI 32-bit Ultra SCSI Fast-20 controller
17" Micron 17FGx, .26dp (15.8" display)

\$3,499
Bus. lease \$119/mo.

*Maximum transmission speed of up to 56Kbps when downloading data and 33.6Kbps when uploading. However, actual performance is dependent upon numerous factors and observed transfer rates may be less than the maximum potentials.

ASSURANCE DOWN THE ROAD.

Micron is a company driven by performance and reliability. Our commitment to building better engineered computers shows. In the past two years, we've collected over 100 awards for product performance, customer service and reliability.

THE MICRON POWER WARRANTY

If we didn't believe so strongly in the quality of our products, we wouldn't back them with such an outstanding warranty. The Micron Power warranty provides coverage with 5-year protection on microprocessors and main memory where most other companies give you three. Our industry-leading warranty offers a 30-day money-back policy. Plus 24-hour technical support.

MICRON POWER[™] WARRANTY

5-year limited warranty on microprocessor and main memory
3-year limited parts-only system warranty (1-year for TransferPort VLSI)
1, 2 or 3-year optional on-site service agreement for Micron desktop and server systems
30 days of free Micron-supplied software support for Micron desktop systems, 3 optional network operating system incident resolutions included for Micron server systems
30-day money back policy
24-hour technical support

The foregoing is subject to and qualified by Micron's standard limited warranties and terms and conditions of sale. Terms and conditions of sale may vary for specific configurations. Copies of the limited warranties may be obtained on our Web site or by calling Micron.



Source: PC World best overall PC company for reliability and service, December 1996.

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enced no IRQ conflicts when installing a different NIC. The system is also DMI-compliant, and its disk features SMART (Self-Monitoring Analysis Reporting Technology), which notifies the user of impending hard disk failure. If the machine is under warranty, the disk can be replaced the next day. Dell's 32-bit MIF browser, Dell Inspector, is included to help you track system assets.

The Optiplex's Intel motherboard integrates an S3 Trio 64V+ graphics subsystem; it was disabled for our tests in favor of a Matrox Millennium card that netted an above-average score on our Graphics WinMark 97 tests. The system was an average performer on most other tests.

The Dimension posted an above-average Disk WinMark score and came in as an average performer on the other tests. The machine's huge 6.2GB hard disk, coupled with the Iomega Zip drive (and three cartridges), should provide plenty of storage space. The Small Business Edition of Microsoft's Office 97 (consisting of Word, Excel, Outlook, and Publisher 97) is also bundled.

Dell offers several service programs, including custom software installation and asset recovery. With these two machines, Dell ably meets the needs of both large and small business users.—*Francis J. Evans*
Dimension XPS M200s. Direct price \$2,999.
Optiplex GXi 5200. Direct price: \$3,245. Dell Computer Corp., Round Rock, TX; 800-388-8542; fax, 512-728-3653; www.dell.com. *Circle 452 on reader service card.*

Diamond Technologies Inc.

Diamond DT-200MMX-CPC

The Diamond DT-200MMX-CPC (\$2,345 direct), from Diamond Technologies, includes Microsoft Office 97 and a 33.6-Kbps modem. Performance is average, except for a below-average CD-ROM WinMark 97 score.

The motherboard accommodates both SIMM and DIMM memory modules, a convenient feature for companies that want to upgrade RAM over time.

Memory and expansion card slots are easily accessible.

This system came to us with some unusual hardware issues. The mouse we received—a three-button Logitech serial device—did not work. Also, the 4MB Diamond Stealth 3D 3000 graphics card



Digital Celebris FX-2 5200M, Diamond DT-200MMX-CPC.

Wizard was slow when we tried to change resolution, so we had to reinstall the driver. Finally, the Hyundai monitor did not produce a sharp picture, although the system's CrystalWave PCI audio card and JUSTer speakers produced clear sound.

Service is somewhat limited. Diamond offers live technical support only during weekday business hours. On-site service is an additional \$149 per year.

Because of its low price, this is a compelling PC for companies that can optimize the system and are not worried about providing their own support.—*FJE*
Diamond DT-200MMX-CPC. Direct price: \$2,345. Diamond Technologies Inc., Anaheim, CA; 800-989-7253; fax, 714-533-7805; www.diamondtech.com. *Circle 453 on reader service card.*

Digital Equipment Corp.

Celebris FX-2 5200M

With Digital Equipment Corp.'s Celebris FX-2 5200M (\$3,640 street), the mantra is *integration*. This slim desktop opts for integrated audio, graphics, and high-speed networking rather than à la carte hardware. Digital's ClientWorks management software and an easy-to-service design makes this PC even more attractive. But the Celebris offers little

room for upgrade or expansion, and its price is higher than its competition's.

Since a 16-bit Sound Blaster-compatible audio subsystem, an S3 ViRGE 2D/3D graphics accelerator, and a Digital Fast Ethernet controller are on the motherboard, no add-in cards are used. The

two card slots are shared PCI/ISA, and there is one empty 5.25-inch drive bay.

The motherboard supports three DIMM slots (or up to 256MB of SDRAM) and two USB ports. The Celebris will also ship with ClientWorks software, which allows for remote management of networked PCs (its latest version had not been finalized as we finished this story).

An average performer highlighted by an above-average Disk WinMark 97 score, the Celebris would be a good addition to the corporate LAN.—*CM*
Celebris FX-2 5200M. Street price: \$3,640. Digital Equipment Corp., Acton, MA; 800-722-9332; fax, 800-367-0436; www.windows.digital.com. *Circle 454 on reader service card.*

DirectWave Inc.

DirectWave MVP X-200

The DirectWave MVP X-200 (\$2,649 direct), a great performer on our benchmark tests, provides system management support through Intel's LANDesk. It also comes with a huge 4.8GB hard disk.

To manage the system in a networked environment, DirectWave provides Intel's LANDesk Client Manager. The system's ASUSTek motherboard has on-board sensors to monitor voltage, temperature, and fan speed, and notifies the user through LANDesk if there is a problem.

The unit has a soft power-off feature, which can power off the PC through software or manually by pressing the power switch for four seconds. The power switch will also place the unit in sleep mode.

New technology, such as Intel's 430TX

SUMMARY OF FEATURES

MMX Pentium PCs

■ YES ■ NO

In alphabetical order by company

	Aberdeen P5-200MMX	ABS Corporate System	AcerPower 9536WM	ACMA EXP200	Advanced Megatrends Apollo 200M5	All Computer Technology ACT P5-200MB	AMAX PowerStation Biz5000X	Caliber Voyager V MMX
Price of tested configuration (32MB RAM, 17-inch monitor, and 4MB graphics adapter)	\$2,791 (direct)	\$1,995 (direct)	\$2,500 (street)	\$2,895 (direct)	\$2,995 (direct)	\$2,298 (direct)	\$3,400 (street)	\$2,449 (direct)
Price with 32MB RAM, 15-inch monitor, and 2MB graphics adapter	\$2,436 (direct)	\$1,725 (direct)	\$2,200 (street)	\$2,495 (direct)	\$2,755 (direct)	\$1,998 (direct)	\$3,100 (street)	\$2,219 (direct)
Installed RAM type	EDO DRAM	EDO DRAM	EDO DRAM	EDO DRAM	SDRAM	SDRAM	SDRAM	EDO DRAM
Hard disk	Maxtor 85120A	Western Digital Caviar AC22100	Quantum Fireball TM3200A	Quantum Fireball TM3200A	Seagate ST52520A	IBM DAQA-32160	Quantum Fireball TM3200A	Western Digital Caviar AC22500
Capacity and interface	4.8GB ATA-3	2GB EIDE	3GB Fast ATA-2	3GB Fast ATA-2	2.4GB Fast ATA-2	2GB ATA-3	3GB Fast ATA-2	2.4GB EIDE
Graphics adapter	Diamond Stealth 3D 2000	Matrox Mystique	STB Nitro 3D	STB Velocity 3D	Diamond Stealth 3D 2000	Matrox Mystique	STB Velocity 3D	Matrox Millennium
Memory	4MB EDO DRAM	4MB SGRAM	4MB SGRAM	4MB VRAM	4MB EDO DRAM	4MB SGRAM	4MB EDO VRAM	4MB VRAM
Graphics chip set	S3 VIRGE	Matrox IS-MGA-1064SG-D	S3 VIRGE/GX	S3 VIRGE	S3 VIRGE	Matrox IS-MGA-1064SG-D	S3 VIRGE/VX	Matrox IS-MGA-2064W-R2
Monitor (and measured diagonal size, in inches)	ViewSonic GT770 (15.9)	Panasonic PM 17 (16.0)	AcerView 78ie (15.8)	ADI Microscan 5V (15.8)	ViewSonic Optiquest V775 (16.0)	ViewSonic Optiquest V775 (16.0)	Impression Vienna PRO 17 (16.0)	Sceptre P73A (16.0)
CD-ROM drive (maximum speed)	Pioneer DR-444 (12X)	IMES/IBM ICD-1800/AT (12X)	Mitsumi CRMCFX120T (12X)	Sony RDX-1258 (16X)	Toshiba XM-5702B (12X)	Hitachi CDR-8130 (16X)	Sony CDU-611 (16X)	Toshiba XM-5702B (12X)
Motherboard Components								
Installed external RAM cache and type	512K pipelined-burst	256K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst
Motherboard manufacturer	SuperMicro	ASUSTek	Acer	Intel	SuperMicro	BCM	Impression	Abit Computer
Chip set	Intel 82430HX	Intel 82430VX	Intel 82430HX	Intel 82430HX	Intel 82430TX	Intel 82430VX	Intel 82430VX	Intel 82430VX
Networking and Communications								
Network adapter	None	None	None	None	Intel EtherExpress Pro 100B LAN	None	Intel EtherExpress Pro 100B LAN	None
Modem speed (data/fax)	33.6/14.4	N/A	N/A	28.8/14.4	28.8/14.4	N/A	33.6/14.4	33.6/14.4
Expandability								
Expansion-bus slots	4 ISA, 4 PCI	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 4 PCI	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA
Front-accessible drive bays (5.25", 3.5")	3, 2	2, 2	3, 2	3, 1	3, 2	3, 2	5, 2	3, 2
Internal drive bays (5.25", 3.5")	0, 2	0, 1	0, 2	0, 2	0, 2	0, 2	1, 1	0, 2
USB ports	■	■	■	■	■	■	■	■
Service and Support								
24-hour, 7-day live technical support	■	■	■	■	■	■	■	■
Standard warranty on parts/labor	1 year/1 year	3 years/lifetime	3 years/3 years	3 years/1 year	3 years/3 years	1 year/1 year	3 years/1 year	2 years/1 year
On-site service charge	\$109.95 (1 year)	N/A	Included (1 year)	Included (1 year)	Included (1 year)	N/A	N/A	Included (1 year)

N/A—Not applicable: The product does not have this feature.

chip set and SDRAM, allowed the DirectWave to post some great test scores: Its Graphics WinMark 97 score placed it in the top ten, and its Disk WinMark 97 score was above average. All other scores were average.

This unit will be tool-free, lockable and supporting infrared by July; our test unit did not have these features. The system's 12X CD-ROM drive will be upgraded to 16X.

The MVP X-200 is a good value: a fast system that offers a great deal of storage and strong management support.—*FJE*
DirectWave MVP X-200. Direct price: \$2,649. DirectWave Inc., Ontario, CA; 800-882-8108; fax, 909-390-8060; www.directwave.com. Circle 455 on reader service card.

DTK Computer Inc.

DTK Quin-55M/PM200

The DTK Quin-55M/PM200 (\$2,730 street) has some desirable features for small business users but lacks a few key components that large businesses may require—including DMI compliance.

One of this unit's greatest assets is its expansion potential. Three internal 3.5-inch bays easily snap out for adding fixed devices; there's also room for three front-accessible 5.25-inch devices. The Quin posted average scores on all our benchmark tests, although its CPUmark₃₂ score was in the low-average range.

In our subjective testing, getting this unit onto the network was no problem,

but expanding the memory may be difficult because cables block the SIMM sockets. The case is tool-free but cannot be locked. Some of the software titles (Magic Carpet and Eradicator) seem incongruous in a business PC; an office suite would be a welcome addition.

Technical support is available only during weekday business hours; on-site service for the first year costs an additional \$50.

The Quin provides all the basics at a fairly good price.—*FJE*

DTK Quin-55M/PM200. Street price: \$2,730. DTK Computer Inc., City of Industry, CA; 800-289-2385, 818-810-0098; fax, 818-810-0090; www.dtkcomputer.com. Circle 456 on reader service card.

Continues



Compaq Deskpro 5200X/4200/PDS	Comtrade Lightning PC	CyberMax Max 16-P200MMX	Dell Dimension XPS M200s	Dell Optiplex GXI 200	Diamond DT-200MMX-CPC	Digital Celebris FX-2 5200M	DirectWave MVP X-200	DTK Quin-55M/PM200	EPS Evolution EV-3 200 MMX
\$5,040 (street)	\$2,695 (direct)	\$2,299 (direct)	\$2,999 (direct)	\$3,245 (direct)	\$2,345 (direct)	\$3,640 (street)	\$2,649 (direct)	\$2,730 (street)	\$2,395 (direct)
\$4,590 (street)	\$2,345 (direct)	\$2,099 (direct)	\$2,599 (direct)	\$2,646 (direct)	\$2,245 (direct)	\$3,180 (street)	\$2,249 (direct)	\$2,260 (street)	\$2,169 (direct)
EDO DRAM	SDRAM	EDO DRAM	SDRAM	EDO DRAM	EDO DRAM	SDRAM	SDRAM	EDO DRAM	SDRAM
Seagate ST34371N	IBM DAQA-33240	Seagate ST52520A	IBM DHEA-36480	Western Digital Caviar AC33100	Western Digital Caviar AC32500	Quantum Fireball ST4320A	Maxtor 85120A	Seagate ST52520A	Quantum Fireball TM3200A
4GB Ultra SCSI	3GB EIDE	2.4GB Fast ATA-2	6.2GB Fast ATA-3	2.9GB EIDE	2.5GB EIDE	4GB EIDE	4.8GB ATA-3	2.4GB Fast ATA-2	3GB Fast ATA-2
Matrox Millennium	STB Nitro 3D	Diamond Stealth 3D 3000	Matrox Millennium	Matrox Millennium	Diamond Stealth 3D 3000	S3 (integrated)	Diamond Stealth 3D 3000	Diamond Stealth 3D 3000	Diamond Stealth 3D 3000
4MB VRAM	4MB EDO DRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB SGRAM	4MB VRAM	4MB VRAM	4MB VRAM
Matrox IS-MGA-2064W-R2	S3 VIRGE/GX	S3 VIRGE/VX	Matrox IS-MGA-2064W-R2	Matrox IS-MGA-2064W-R2	S3 VIRGE/VX	S3 VIRGE/GX	S3 VIRGE/VX	S3 VIRGE/VX	S3 VIRGE/VX
Compaq P70 (15.8)	MAG Innovision DJ700 (16.0)	Princeton E075 (16.0)	Dell D1728D-LS (16.5)	Dell D1728D-LS (16.5)	Hyundai Delux-Scan 17B+ (15.5)	LG Electronics CS771 (16.2)	MAG Innovision DJ700 (16.0)	MAG Innovision DJ700 (16.0)	CTX 1785XA (16.1)
Matsushita LF-1195C PD/CD (6X)	Toshiba XM-5702B (12X)	Toshiba XM-5702B (12X)	Mitsumi CRMC-FX120T (12X)	NEC CDR-1400A (8X)	Samsung SCR-A30 (8X)	Toshiba XM-5702B (12X)	Toshiba XM-5702B (12X)	Toshiba XM-5702B (12X)	Mitsumi CRMC-FX120T (12X)
512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	256K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst
Compaq	ASUSTek	M Technology	Dell	Dell	BCM	Digital	ASUSTek	DTK	BCM
Compaq 185051-100	Intel 82430TX	SiS 5571	Intel 82430VX	Intel 82430HX	Intel 82430VX	Intel 82430TX	Intel 82430TX	Intel 82430HX	Intel 82430TX
Ethernet NetFlex-3 10BaseT	Intel EtherExpress Pro 100B LAN	None	None	3Com 3C905TX	None	Integrated DEC 21143 10BaseT 100BaseTX	None	None	None
N/A	33.6/14.4	33.6/14.4	33.6/14.4	N/A	33.6/14.4	N/A	33.6/14.4	N/A	33.6/14.4
3 ISA, 4 PCI	3 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 2 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA
3, 1	3, 2	4, 1	2, 3	2, 1	3, 2	2, 1	3, 3	4, 1	3, 2
0, 1	0, 2	0, 3	1, 1	0, 2	0, 2	0, 1	0, 1	0, 3	0, 2
■	■	■	■	■	■	■	■	■	■
3 years/1 year	3 years/1 year	3 years/1 year	3 years/3 years	3 years/3 years	1 year/3 years	3 years/1 year	3 years/3 years	2 years/2 years	3 years/3 years
Included (1 year)	\$50 (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	\$149 (1 year)	Included (1 year)	Included (1 year)	\$50 (1 year)	Included (1 year)

EPS Technologies Inc.

Evolution EV-3 200 MMX

EPS Technologies' Evolution EV-3 200 MMX (\$2,395 direct) is a good value, offering average performance, plenty of storage space, a 33.6-Kbps modem, and a great software bundle. A minor drawback is that there were no free IRQs.

The Evolution made its best showing on our Graphics WinMark 97 tests, with a score that just missed the above-average mark by one point. A 4,500-rpm 3GB hard disk was mainly responsible for the unit's low-average scores on our Disk WinMark 97 and Business Winstone 97 tests.

Getting the unit onto our network was a chore: Since the system had no free IRQs,

we had to set the configuration manually. The Ensoniq PCI sound card and Labtec speakers had resonant sound, but the monitor had a visible line across the screen and picture quality wasn't very clear.

EPS offers you a choice of Microsoft Office 97 Small Business Edition, Corel Office Version 7 Professional Edition, or Lotus SmartSuite 97 preinstalled. A second preinstalled package costs only \$99.

The Evolution is a good value for a small business looking for lots of software and storage at an affordable price.—*FJE*
Evolution EV-3 200MMX. Direct price: \$2,395. EPS Technologies Inc., Omaha, NE; 800-447-0921; fax, 402-891-9383; www.epstech.com. *Circle 457 on reader service card.*

Everex Systems Inc.

Everex Step Premier

The Everex Step Premier (\$2,599 direct) offers a great support and warranty program and a software bundle that should appeal to its target audience of home office buyers. Its price is somewhat higher than other comparably equipped PCs here, however.

Servicing this PC is awkward. The memory slots are hidden behind the CD-ROM drive and a big tangle of cables; the parallel port is blocking one of the PCI slots. The motherboard is designed so that none of the slots are shared, hence plenty are available.

The Step Premier posted below-average

SUMMARY OF FEATURES

MMX Pentium PCs



■ YES ■ NO

In alphabetical order by company

	Everex Step Premier	Gateway P5-200 Professional	GST Aapogee 9000PT	HD Victoria Platinum 200MMX	Hertz P200e	Hewlett-Packard Vectra XA 5/200	HiQuality HIQ-ECW-200	Hymco HWS-5200MX
Price of tested configuration (32MB RAM, 17-inch monitor, and 4MB graphics adapter)	\$2,599 (direct)	\$2,653 (direct)	\$2,499 (direct)	\$2,399 (direct)	\$2,485 (direct)	\$3,160 (street)	\$2,438 (direct)	\$3,299 (direct)
Price with 32MB RAM, 15-inch monitor, and 2MB graphics adapter	\$2,199 (direct)	\$2,423 (direct)	\$2,173 (direct)	\$1,995 (direct)	\$2,135 (direct)	\$2,790 (street)	\$2,018 (direct)	\$2,899 (direct)
Installed RAM type	EDO DRAM	SDRAM	SDRAM	EDO DRAM	SDRAM	EDO DRAM	EDO DRAM	EDO DRAM
Hard disk	Western Digital Caviar AC22100	Quantum Fireball TM2550A	Quantum XP32150W	Western Digital Caviar AC33100	Western Digital Caviar AC33100	Quantum Fireball TM2550A	IBM DAQA-32160	Seagate Barracuda ST32171W
Capacity and interface	2GB EIDE	2.4GB EIDE	2GB Fast/Wide SCSI-2	2.9GB EIDE	2.9GB EIDE	2.4GB EIDE	2GB Fast/Wide SCSI-2	2GB Ultra Wide SCSI
Graphics adapter	Matrox Millennium	STB Velocity 3D	Diamond Stealth 3D 3000	Matrox Millennium	Matrox Mystique	Matrox Millennium	Diamond Stealth 3D 3000	Matrox Millennium
Memory	4MB WRAM	4MB EDO VRAM	4MB VRAM	4MB WRAM	4MB SGRAM	4MB WRAM	4MB EDO VRAM	4MB WRAM
Graphics chip set	Matrox IS-MGA-2064W-R2	S3 VIRGE/VX	S3 VIRGE/VX	Matrox IS-MGA-2064W-R2	Matrox IS-MGA-1064SG-D	Matrox IS-MGA-2064W-R2	S3 VIRGE/VX	Matrox IS Storm R2
Monitor (and measured diagonal size, in inches)	Shamrock C705T (15.7)	Gateway C2 700 (15.9)	NEC MultiSync XV17+ (15.4)	Iiyama MT-9017E (15.9)	Princeton Ultra (15.8)	HP Ultra VGA 1280 (15.5)	Panasonic S17 (15.8)	NEC MultiSync M700 (15.8)
CD-ROM drive (maximum speed)	NEC CDR-1400A (8X)	Mitsumi CRMC-FX140S2 (16X)	Hitachi CDR-8130 (16X)	Toshiba XM-5702B (12X)	Toshiba XM-5702B (12X)	HP D4381-60001 (8X)	Matsushita CR-5DY (12X)	Matsushita CR-506-B (8X)

Motherboard Components

Installed external RAM cache and type	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	256K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	256K pipelined-burst
Motherboard manufacturer	FIC	Gateway	Tyan	Intel	ITWill OEM	Hewlett-Packard	ASUSTek	Intel
Chip set	Intel 82430HX	Intel 82430VX	Intel 82430TX	Intel 82430HX	Intel 82430VX	Intel 82430HX	Intel 82430HX	Intel 82430HX

Networking and Communications

Network adapter	None	None	None	None	None	HP Enhanced 10/100 BaseT Ethernet	None	None
Modem speed (data/fax)	N/A	33.6/14.4	33.6/14.4	33.6/14.4	N/A	N/A	N/A	N/A

Expandability

Expansion-bus slots	3 ISA, 4 PCI	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 4 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	4 ISA, 2 PCI, 1 PCI/ISA	1 ISA, 2 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA
Front-accessible drive bays (5.25", 3.5")	3, 2	3, 1	3, 2	3, 2	3, 2	1, 2	3, 2	3, 2
Internal drive bays (5.25", 3.5")	0, 3	0, 4	0, 1	0, 2	1, 0	0, 1	0, 1	0, 2
USB ports	■	■	■	■	■	■	■	■

Service and Support

24-hour, 7-day live technical support	■	■	■	■	■	■	■	■
Standard warranty on parts/labor	5 years/5 years	3 years/3 years	1 year/1 year	1 year/1 year	3 years/3 years	3 years/3 years	3 years/1 year	2 years/2 years
On-site service charge	Included (1 year)	Included (1 year)	\$50 (1 year)	\$44.95 (1 year)	\$195 (1 year)	Included (1 year)	\$69 (1 year)	N/A

N/A—Not applicable. The product does not offer this feature.

Graphics and CD-ROM WinMark scores; all other test scores were average. Everex Systems bundles Microsoft Works, Money, and Encarta 96 Encyclopedia. DMI will be supported by September 1997.

Everex provides 24-hour technical support and on-site service for the first year, plus a five-year parts-and-labor warranty.

The Step Premier offers perks for the small business—an excellent warranty and support program and software bundle—but doesn't have the system management features a large corporation needs.—*FJE*
Everex Step Premier. Direct price: \$2,599. Everex Systems Inc., Fremont, CA; 800-383-7391, 510-498-1111; fax, 510-683-2186; www.everex.com. *Circle 458 on reader service card.*

Gateway 2000.

Gateway P5-200 Professional

Continuing Gateway 2000's tradition of providing lots of great hardware for an affordable price, the Gateway P5-200 Professional (\$2,653 direct) adds features that will make network administrators happy—including a DMI service layer and a browser for tracking system assets.

The P5-200 comes with top-gun hardware such as an STB Velocity 3D graphics card with 4MB of EDO VRAM and a 36.6/14.4-Kbps data/fax modem, then adds a 100MB Iomega Zip drive. This is an attractive hardware plus, but it takes up the last open IRQ address, so installing expansion cards or drives is a bit of a hassle.

sion cards or drives is a bit of a hassle.

The P5-200 was a mostly average performer. But despite its 16X CD-ROM drive, it posted a below-average CD-ROM WinMark 97 score. Its Disk WinMark 97 score was also below average. On the plus side, Gateway will preload your software—whether it be Microsoft Office or custom apps—so that the units are ready to go out of the box.

Good hardware and warranty support make this system worth considering.—*Mary E. Behr*

Gateway P5-200 Professional. Direct price: \$2,653. Gateway 2000, N. Sioux City, SD; 800-846-2000, 605-232-2000; fax, 605-232-2023; www.gw2k.com. *Circle 459 on reader service card.*

Continues

IBM PC350	Intergraph TD-25	Kingdom Pentium MMX 200 Value	Magitronic G-P200MX	Maximus Magna Media	Mega Impact Pentium/MMX200	Micro Express MicroFlex-MMX/200	Micron Millennium MME P200	Microniche MIS-55PM	Micro X MXP-5000
\$4,000 (street)	\$2,940 (street)	\$2,397 (direct)	\$3,000 (street)	\$2,399 (direct)	\$3,500 (direct)	\$2,599 (direct)	\$2,418 (direct)	\$2,499 (direct)	\$3,379 (direct)
\$3,210 (street)	\$2,600 (street)	\$2,147 (direct)	\$2,700 (street)	\$1,999 (direct)	\$3,030 (direct)	\$2,299 (direct)	\$2,218 (direct)	\$2,199 (direct)	\$2,579 (direct)
EDO DRAM	EDO DRAM	SDRAM	EDO DRAM	EDO DRAM	SDRAM	EDO DRAM	SDRAM	FPM DRAM	SDRAM
IBM Aquarius DAQA-32700	Fujitsu MPA3035AT	Quantum Fireball TM3200A	Seagate ST52520A	Maxtor 85120A	Quantum Atlas II XP34550W	Quantum XP32150W	Quantum Stratus	Western Digital Caviar AC22100	Quantum XP34300W
2 4GB EIDE	3 3GB EIDE	3GB Fast ATA-2	2 4GB Fast ATA-2	4 8GB ATA-3	4 2GB Ultra Wide SCSI-3	2 1GB Fast/Wide SCSI-2	3GB Ultra DMA-33	2GB EIDE	4 1GB Ultra Wide SCSI
STB Velocity 3D	Matrox Millennium	Jaton Video 58P	Diamond Stealth 3D 3000	ATI All-in-Wonder	Diamond Stealth 3D 3000	STB Velocity 3D	Diamond Stealth 3D 2000	Matrox Millennium	Matrox Millennium
4MB EDO VRAM	4MB WRAM	4MB MDRAM	4MB VRAM	4MB SGRAM	4MB VRAM	4MB EDO VRAM	4MB EDO DRAM	4MB WRAM	8MB WRAM
S3 ViRGE/VX	Matrox IS-MGA-2064W-R2	Tseng ET6000	S3 ViRGE/VX	ATI 3D Rage II	S3 ViRGE/VX	S3 ViRGE/VX	S3 ViRGE/DX	Matrox IS-MGA-2064W-R2	Matrox IS-MGA-2064W-R2
IBM G70 (15.8)	Panasonic 17SD69 (15.8)	Panasonic 517 (15.8)	Magitronic C-SV1700PS (15.8)	CTX 765D (15.8)	iyama MF-8617E (15.8)	MAG Innovation DX700T (16.5)	ADI 5V LM-1764 (16.0)	Utopia XP400 (16.0)	MAG Innovation DX700T (16.5)
Hitachi CDR-8130 (16X)	Toshiba XM-5702B (12X)	Goldstar CDR-8160B (16X)	Goldstar CDR-8160B (16X)	Lite-on LTN262A (12X)	Hitachi CRD-8130 (16X)	Toshiba XM-5702B (12X)	Hitachi CDR-8130 (16X)	NEC CDR-1400A (8X)	Goldstar CRD-8160B (16X)
512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	256K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst	256K pipelined-burst	512K pipelined-burst
IBM	Micronics	Gemlight	Giga-Byte	SuperMicro	BCM	BCM	Intel	Micronics	Tyan
Intel 82430HX	Intel 82430TX	Intel 82430VX	Intel 82430VX	Intel 82430HX	Intel 82430VX	Intel 82430VX	Intel 82430TX	Intel 82430HX	Intel 82430TX
None	None	None	None	None	None	None	None	None	None
N/A	N/A	N/A	N/A	33.6/14.4	33.6/14.4	33.6/14.4	N/A	N/A	33.6/14.4
3 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 4 PCI	3 ISA, 4 PCI	4 ISA, 4 PCI	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 4 PCI, 1 PCI/ISA
2, 1	2, 1	4, 1	4, 1	3, 2	4, 1	3, 2	2, 3	3, 2	3, 2
0, 2	0, 3	0, 4	0, 6	0, 2	0, 4	0, 1	0, 2	0, 1	0, 1
■	■		■	■	■	■	■	■	■
3 years/3 years	3 years/1 year	3 years/3 years	2 years/2 years	1 year/lifetime	2 years/2 years	4 years/4 years	3 years/1 year	1 year/1 year	3 years/5 years
Included (1 year)	Included (1 year)	Included (1 year)	\$89 (1 year)	Included (1 year)	N/A	\$50 (1 year)	Included (1 year)	\$35 (1 year)	Included (1 year)

GST/Micro City Inc.

Aapogee 9000PT

GST/Micro City's Aapogee 9000PT (\$2,499 direct) brings to the table excellent disk and graphics performance and some attractive hardware.

The Aapogee's midtower case offers easy access to components. The ATX-style Tyan motherboard provides plenty of expansion potential, with four PCI slots and a maximum system memory capacity of 256MB. The machine also includes some impressive peripheral components: a 16X Hitachi CD-ROM drive, a 33.6/14.4-Kbps voice modem, a Creative Labs Sound Blaster AWE64 audio adapter, and a set of Altec Lansing ACS 45 speakers.

The Aapogee yielded mostly average results on our tests. However, thanks to its 2GB Quantum Fast/Wide SCSI-2 hard disk hooked to an Adaptec 2940UW Ultra Wide SCSI controller, it posted a top-ten Disk WinMark 97 score. Using a Diamond Stealth 3D 3000 graphics board with 4MB of VRAM, the Aapogee achieved an above-average Graphics WinMark 97 score.

The Aapogee 9000PT offers good hardware and strong disk performance at an attractive price.—*Robert S. Anthony*
Aapogee 9000PT. Direct price: \$2,499. GST/Micro City Inc., Cerritos, CA; 800-567-2764, 714-739-0106; fax, 714-670-6404; www.aapogee.com. *Circle 460 on reader service card.*

HD Systems Inc.

Victoria Platinum 200MMX

The Victoria Platinum 200MMX (\$2,399 direct) delivers decent performance, good design, and high-quality components. Although it lacks some frills, the unit represents a reasonable option for business users.

The unit affords easy access to the memory and expansion slots as well as to the drive bays. The ATX motherboard has an integrated Yamaha sound chip set. A U.S. Robotics 33.6/14.4-Kbps modem was also bundled.

The Victoria Platinum scored consistently within the low-average range on our tests. Its result on the Disk WinMark 97

SUMMARY OF FEATURES

MMX Pentium PCs

	MidWest Micro MWO-200-X Office PC	Mitsuba Premier System- 200MMX	NMC Expert- MMX200	Nova P55-200MMX	Polywell Poly 5200Tx8	Premio TX-P200M	ProGen Atlas X-200	Quantax QPS/200 SM-3X
■ YES ■ NO								
In alphabetical order by company								
Price of tested configuration (32MB RAM, 17-inch monitor, and 4MB graphics adapter)	\$2,799 (direct)	\$2,900 (street)	\$2,395 (direct)	\$2,549 (direct)	\$2,750 (direct)	\$2,610 (street)	\$2,229 (direct)	\$2,999 (direct)
Price with 32MB RAM, 15-inch monitor, and 2MB graphics adapter	\$2,510 (direct)	\$2,450 (street)	\$2,195 (direct)	\$2,249 (direct)	\$2,350 (direct)	\$2,350 (street)	\$1,849 (direct)	\$2,699 (direct)
Installed RAM type	SDRAM	SDRAM	EDO DRAM	EDO DRAM	SDRAM	SDRAM	SDRAM	EDO DRAM
Hard disk	IBM DCAA-34330	Maxtor 82500A	Western Digital Caviar AC33100	Quantum Fireball TM3200A	Maxtor 85120A	Quantum Atlas II XP34550W	IBM DADA-33240	Seagate Barra- cude ST34371W
Capacity and interface	4GB ATA-3	2.4GB ATA-3	2.9GB EIDE	3GB Fast ATA-2	4.8GB ATA-3	4.2GB Ultra Wide SCSI-3	3GB ATA-3	4GB Ultra Wide SCSI
Graphics adaptor	ATI 3D Pro Turbo PC2TV	STB Velocity 3D	Matrox Mystique	Diamond Stealth 3D 2000	Matrox Millennium	ATI 3D Pro Turbo PC2TV	Matrox Millennium	Matrox Millennium
Memory	4MB SGRAM	8MB EDO & VRAM	4MB SGRAM	4MB EDO DRAM	4MB WRAM	4MB SGRAM	4MB WRAM	4MB WRAM
Graphics chip set	ATI 3D Rage II	S3 VIRGE/VX	Matrox IS-MGA- 1064SG-D	S3 VIRGE	Matrox IS-MGA- 2064W-R2	ATI 3D Rage II	Matrox IS-MGA- 2064W-R2	Matrox IS-MGA- 2064W-R2
Monitor (and measured diagonal size, in inches)	MAG Innovision DJ702e (16.0)	Hyundai Delux- Scan 17Pro (15.5)	ADI 5V LW-1784 (16.0)	CTX VL700 (16.1)	Iiyama MF-8617E (15.8)	Sceptre OEM (15.8)	KSL K-720 (16.9)	MAG Innovision DX700T (16.5)
CD-ROM drive (maximum speed)	Mitsumi CRM- FX140S2 (16X)	Toshiba XM- 5702B (12X)	Cyberdrive 1200 (12X)	Toshiba XM- 5702B (12X)	Matsushita CR- 584-B (12X)	Mitsumi CRM- FX120T (12X)	Sony CDU-511 (16X)	Toshiba XM- 5702B (12X)
Motherboard Components								
Installed external RAM cache and type	512K pipelined- burst	512K pipelined- burst	512K pipelined- burst	512K pipelined- burst	512K pipelined- burst	256K pipelined- burst	512K pipelined- burst	512K pipelined- burst
Motherboard manufacturer	Microstar	BCM	ASUSTek	ASUSTek	Tyan	Microstar	BCM	Netrix
Chip set	Intel 82430VX	Intel 82430VX	Intel 82430VX	Intel 82430HX	Intel 82430TX	Intel 82430TX	Intel 82430VX	Intel 82430VX
Networking and Communications								
Network adapter	None	None	None	None	None	None	None	None
Modem speed (data/fax)	33.6/14.4	N/A	33.6/14.4	N/A	33.6/14.4	N/A	33.6/14.4	33.6/14.4
Expandability								
Expansion-bus slots	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 2 PCI, 1 PCI/ISA	4 ISA, 3 PCI
Front-accessible drive bays (5.25", 3.5")	3, 2	4, 1	3, 1	4, 1	3, 2	3, 2	3, 2	4, 1
Internal drive bays (5.25", 3.5")	0, 2	0, 4	0, 2	0, 4	0, 1	0, 1	0, 3	0, 3
USB ports	■	■	■	■	■	■	■	■
Service and Support								
24-hour, 7-day live technical support	■	■	■	■	■ (first year)	■	■	■
Standard warranty on parts/labor	3-5 years/ 3-5 years	2 years/2 years	3 years/3 years	3 years/3 years	3 years/5 years	3 years/3 years	3 years/1 year	3 years/1 year
On-site service charge	N/A	Included (2 years)	\$39 (1 year)	\$50 per year	Included (1 year)	\$50 (1 year)	Included (1 year)	Included (1 year)
N/A—Not applicable: The product does not offer this feature.								

tests reflects the spin rate of its hard disk—5,200 rpm—in a field with faster devices.

HD Systems performs a presale product burn-in to test system durability; each PC is placed in a 110-degree room and monitored for 72 hours. The company offers lifetime toll-free phone support and a one-year parts-and-labor warranty.

While other systems may have more flair, the Victoria Platinum 200MMX has the makings of a reliable workhorse. For the money, it is a choice worth considering.—*Josh Levy*

Victoria Platinum 200MMX. Direct price: \$2,399. HD Systems Inc., Santa Clara, CA; 888-988-9901, 408-986-9898; fax, 408-566-0720; www.hdcomputer.com. *Circle 461 on reader service card.*

Hertz Computer Corp.

Hertz P200e

The Hertz P200e (\$2,485 direct) was a respectable performer and is priced right, but its drive expansion is limited, and it lacks checklist features that large corporations seek.

The system's motherboard has both DIMM and SIMM slots and can support either EDO or SDRAM. The hard disk is mounted in the center of two front-accessible 3.5-inch drive bays, even though there's a mounting bracket for another drive.

The system included a mediocre Princeton monitor. At 640-by-480 resolution, the screen was distorted and required extensive manual adjustment.

Higher resolutions also posed problems, sometimes defaulting to distractingly low refresh rates. For example, at 1,024-by-768, the refresh rate defaults to 60 Hz.

The P200e yielded average results on most tests. The only exception was a below-average score on the Graphics WinMark 97 tests, influenced by its Matrox Mystique graphics card.

Although the Hertz P200e is competent and attractively priced, it may be better suited to small businesses rather than large corporations.—*JL*

Hertz P200e. Direct price: \$2,485. Hertz Computer Corp., New York; 888-222-7280, 212-634-4280; fax, 212-634-4285; www.hertzttec.com. *Circle 462 on reader service card.*

COVER STORY
MMX Pentium PCs

Continues

Reason Square One HO/M-200	Royal Power Graph UW	SAG STA 200 MMX	Seamix CS Plus 200	STD CompuPartner MMX5-200	Summit Micro Design Mount Shasta MMX	Supercom Touch MMX200-210	Sys Performance P200T2M	Tegran Thunderbolt MXL 200	Tangent 5200M
\$3,395 (direct)	\$3,995 (direct)	\$3,330 (direct)	\$2,499 (direct)	\$2,500 (street)	\$2,595 (direct)	\$2,530 (street)	\$2,598 (direct)	\$3,265 (direct)	\$2,395 (direct)
\$3,045 (direct)	\$3,650 (direct)	\$3,030 (direct)	\$2,299 (direct)	\$1,990 (street)	\$2,100 (direct)	\$2,180 (street)	\$2,278 (direct)	\$2,986 (direct)	\$1,995 (direct)
SDRAM	EDO DRAM	EDO DRAM	SDRAM	EDO DRAM	SDRAM	EDO DRAM	EDO DRAM	EDO DRAM	SDRAM
Seagate ST34501W	Seagate ST34501W	Seagate ST34501W	Western Digital Caviar AC34000	Western Digital Caviar AC33100	Maxtor 82560A	Western Digital Caviar AC22100	IBM DAQA- 33240	Seagate ST34501W	IBM DAQA- 33240
4.2GB Ultra Wide SCSI	4.2GB Ultra Wide SCSI	4.2GB Ultra Wide SCSI	3.7GB EIDE	2.9GB EIDE	2.4GB Fast ATA-2	2GB EIDE	3GB ATA-3	4.2GB Ultra Wide SCSI	3GB ATA-3
Hercules Terminator 3D	STB Velocity 3D	Number Nine 9FX Reality 772	Matrox Mystique	Matrox Millennium	Diamond Stealth 3D 3000	Diamond Stealth 3D 3000	Diamond Stealth 3D 3000	Matrox Millennium	STB Velocity 3D
4MB EDO DRAM	4MB EDO VRAM	4MB EDO VRAM	4MB SGRAM	4MB WRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB WRAM	4MB EDO VRAM
S3 VIRGE	S3 VIRGE/VX	S3 VIRGE/VX	Matrox IS-MGA- 1064SG-D	Matrox IS-MGA- 2064W-R2	S3 VIRGE/VX	S3 VIRGE/VX	S3 VIRGE/VX	Matrox IS-MGA- 2064W-R2	S3 VIRGE/VX
MAG innovation DX700T (16.5)	Wyse LN-917PS (16.0)	Princeton E075 (16.0)	Sampo KN-730 (16.0)	NeuDenko NX17 (15.8)	CyberVision D569 (16.0)	MicroScan 5V LM-1764 (15.8)	KDS OEM (15.8)	Proton OEM (16.0)	CTX 1785D (16.0)
Goldstar CRD- 8160B (16X)	Toshiba XM- 3801TA (16X)	Toshiba XM- 5702B (12X)	Mitsumi CRM- FX14S2 (16X)	Matsushita CR- 584-B (12X)	Mitsumi CRM- FX120T (12X)	Mitsumi CRM- FX140S2 (16X)	TEAC CD-512E (12X)	Toshiba XM- 3801TA (16X)	Toshiba XM- 5702B (12X)
512K pipelined- burst	512K pipelined- burst	512K pipelined- burst	512K pipelined- burst	512K pipelined- burst	512K pipelined- burst	512K pipelined- burst	512K pipelined- burst	512K pipelined- burst	512K pipelined- burst
Tyan	ASUSTek	Intel	Seamix	Microstar	ASUSTek	SuperMicro	Giga-Byte	Tyan	Tyan
Intel 82430TX	Intel 82430VX	Intel 82430HX	Intel 82430TX	Intel 82430HX	Intel 82430TX	Intel 82430TX	Intel 82430HX	Intel 82430TX	Intel 82430TX
None	None	None	None	None	CardWare Labs CWL9512	None	None	None	None
N/A	33.6/14.4	N/A	N/A	N/A	N/A	33.6/14.4	33.6/14.4	N/A	N/A
2 ISA, 4 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 4 PCI, 1 PCI/ISA
2, 1	3, 2	3, 2	3, 2	3, 2	3, 1	4, 2	3, 2	3, 2	2, 3
0, 2	0, 1	0, 2	0, 2	0, 3	0, 2	0, 2	0, 3	0, 2	0, 3
■	■	■	■	■	■	■	■	■	■
■	■	■	■ (by mid-June)	■	■	■	■	■	■
3 years/6 years	1 year/1 year	2-5 years/ 2-5 years	3-5 years/ 3 years	2 years/2 years	3 years/3 years	1 year/1 year	1-6 years/1 year	3 years/1 year	3 years/3 years
\$49 per year	\$250 (4 years)	\$35 (1 year)	\$49.98 (1 year)	Included (1 year)	Included (1 year)	\$60 (1 year)	Included (1 year)	\$49 (1 year)	Included (1 year)

Hewlett-Packard Co.

HP Vectra XA 5/200



If managing PCs on your corporate LAN gives you a migraine, you obviously aren't tracking any HP Vectras, and we think you should be. Hewlett-Packard's HP Vectra XA 5/200 (\$3,160 street)—an

Editors' Choice in this roundup—is one exceedingly impressive PC, from its ease-of-serviceability features to HP's TopTools, the most complete and easy-to-use management solution we've seen to date.

The Vectra isn't merely DMI-compliant. With TopTools, you can monitor not only all DMI-manageable attributes as

outlined by the DMTF, but also dozens of additional attributes through HP's DMI extensions. The Vectra also includes McAfee VirusScan and WebScan, and a



Fast Ethernet adapter; all housed in a lockable, tool-free, modular case. The power supply is easily removed to provide access to the motherboard, and the front panel includes a LAN-activity light as well as a headphone jack with a volume control.

The Vectra's Matrox Millennium graphics card with 4MB of WRAM helped it to an above-average Graphics WinMark 97 result. Other scores were very competitive.

Network-readiness and a maintenance-friendly design make the HP Vectra XA 5/200 a winner.—RSA

HP Vectra XA 5/200. Street price: \$3,160. Hewlett-Packard Co., Palo Alto, CA; 800-752-0900; fax, 800-231-9300; www.hp.com. Circle 463 on reader service card.

SUMMARY OF FEATURES

MMX Pentium PCs

■ YES ■ NO

In alphabetical order by company

	Toshiba Equium 5200D	Total Peripherals Archer-2000	TradeMark TM200MMX	Transsource-MTX200	Tri-Star Tri-CAD IAS MMX	Unitak UT-P200MMX Trojan	Vektron Home Office 200M
Price of tested configuration (32MB RAM, 17-inch monitor, and 4MB graphics adapter)	\$2,900 (street)	\$3,199 (direct)	\$2,800 (street)	\$2,108 (direct)	\$2,600 (street)	\$2,725 (direct)	\$2,395 (direct)
Price with 32MB RAM, 15-inch monitor, and 2MB graphics adapter	\$2,550 (street)	\$3,089 (direct)	\$2,450 (street)	\$1,773 (direct)	\$2,230 (street)	\$2,300 (direct)	\$1,945 (direct)
Installed RAM type	EDO DRAM	SDRAM	EDO DRAM	EDO DRAM	EDO DRAM	EDO DRAM	EDO DRAM
Hard disk	Maxtor 82580A	Seagate ST34371W	Seagate ST52520A	Western Digital Caviar AC33100	Quantum Fireball TM3840A	Quantum XP34550W	Quantum Fireball TM3840A
Capacity and interface	2.4GB Fast ATA-2	4GB Ultra Wide SCSI	2.4GB Fast ATA-2	2.9GB EIDE	3.6GB Fast ATA-2	4.2GB Ultra Wide SCSI-2	3.6GB Fast ATA-2
Graphics adapter	ATI (integrated)	Matrox Millennium	STB Velocity 3D	Matrox Mystique	STB Velocity 3D	Diamond Stealth 3D 3000	Matrox Mystique
Memory	4MB SGRAM	4MB VRAM	4MB EDO VRAM	4MB SGRAM	4MB EDO VRAM	4MB VRAM	4MB SGRAM
Graphics chip set	ATI 3D Rage II	Matrox IS-MGA-2064W-R2	S3 VIRGE/VX	Matrox IS-MGA-1064SG-D	S3 VIRGE/VX	S3 VIRGE/VX	Matrox IS-MGA-1064SG-D
Monitor (and measured diagonal size, in inches)	Toshiba DP782M-01 (16.0)	AcerView 781e (15.8)	Delta OEM (16.3)	Smile International OEM (15.8)	Iiyama MF-8617E (15.8)	ViewSonic 1789GA-1 (18.0)	MAG Innovision DX700T (16.5)
CD-ROM drive (maximum speed)	Toshiba XM-5702B (12X)	Acer 616A (16X)	TEAC CD-512E (12X)	TEAC CD-512E (12X)	Mitsumi CRMCFX120T (12X)	Mitsumi CRMCFX120T (12X)	Goldstar CDR-8160B (16X)
Motherboard Components							
Installed external RAM cache and type	256K pipelined-burst	512K pipelined-burst	512K pipelined-burst	256K pipelined-burst	512K pipelined-burst	512K pipelined-burst	512K pipelined-burst
Motherboard manufacturer	Intel	ASUSTek	First International	Intel	DFI	Shuttle Computer	Gemlight
Chip set	Intel 82430HX	Intel 82430TX	Intel 82430HX	Intel 82430HX	Intel 82430HX	Intel 82430VX	Intel 82430HX
Networking and Communications							
Network adapter	Intel EtherExpress PRO 10/100 (integrated)	None	None	None	None	None	None
Modem speed (data/fax)	N/A	33.6/14.4	33.6/14.4	N/A	N/A	N/A	33.6/14.4
Expandability							
Expansion-bus slots	2 ISA, 1 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 4 PCI	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA	2 ISA, 3 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA
Front-accessible drive bays (5.25", 3.5")	2, 1	3, 1	3, 2	3, 2	3, 2	3, 2	3, 2
Internal drive bays (5.25", 3.5")	0, 1	0, 2	0, 3	0, 1	0, 2	0, 1	0, 1
USB ports	■	■	■	■	■	■	■
Service and Support							
24-hour, 7-day live technical support	■	■	■	■	■	■	■
Standard warranty on parts/labor	3 years/3 years	3 years/1 year	3 years/3 years	3 years/3 years	3 years/lifetime	1 year/1 year	1 year/1 year
On-site service charge	Included (1 year)	\$99 (1 year)	\$50 (1 year)	N/A	\$49 (1 year)	\$75 (1 year)	\$50 (1 year)

N/A—Not applicable: The product does not offer this feature.

HiQuality Systems Inc.

HiQuality HIQ-ECW-200

Bargain hunters will look twice at the HiQuality HIQ-ECW-200 (\$2,438 direct). This inexpensive MMX Pentium PC kept up with its competition on our tests, and it offers the basics you need to get the job done.

Presented in a standard mini-tower case, the HIQ-ECW-200 is based on an ASUSTek motherboard that uses Intel's 430HX chip set and EDO DRAM. The unit's memory slots were a little difficult to access. Two expansion slots are occupied by a Diamond Stealth 3D 3000 graphics card with 4MB of EDO VRAM and a 16-bit Creative Labs sound card,

but there is plenty of room left for additional hardware such as a modem or network card.

The unit also features a 2GB IBM Fast/Wide SCSI-2 hard disk, which was an average performer but was smaller than many offered in this roundup. A Matsushita 12X CD-ROM drive and Yamaha speakers assist with multimedia functions. All test scores were average.

The HIQ-ECW-200 isn't DMI-compliant and doesn't offer an integrated networking option, so it may not be suitable for large corporate installations that demand such features. What it does offer is respectable performance at a reasonable price.—*MEB*

HiQuality HIQ-ECW-200. Direct price: \$2,438.

HiQuality Systems Inc., Sunnyvale, CA; 800-827-5836, 408-245-5836; fax, 408-245-3108; www.hiq.com. *Circle 464 on reader service card.*

Hymco Technologies Inc.

Hymco HWS-5200MX

The Hymco HWS-5200MX (\$3,299 direct) provides some attractive components, including an NEC monitor with integrated speakers. Other systems in this roundup, however, match this unit's features and performance for much less money.

The HWS-5200MX was a fairly good performer. Its 2GB Seagate Barracuda Ultra Wide SCSI hard disk was somewhat

Ends

Xi MX200 MTower	ZDS Performance 200x
\$2,549 (direct)	\$2,899 (direct)
\$2,239 (direct)	\$2,429 (direct)
SDRAM	EDO DRAM
Maxtor 85120A	Western Digital Caviar AC33100
4 8GB ATA-3	2.9GB EIDE
STB Velocity 3D	Diamond Stealth 3D 3000
4MB EDO VRAM	4MB VRAM
S3 VIRGE/VX	S3 VIRGE/VX
ViewSonic Opti-quest V773 (16 0)	Sampo AlphaScan 760 (16 0)
Goldstar CRD-8160B (16X)	Toshiba XM-5702B (12X)
512K pipelined-burst	512K pipelined-burst
Tyan	ASUSTek
Intel 82430TX	Intel 82430HX
None	None
N/A	33.6/14.4
3 ISA, 4 PCI, 1 PCI/ISA	3 ISA, 3 PCI, 1 PCI/ISA
4, 2	3, 1
0, 2	0, 2
■	■
■	■
3 years/3 years Included (1 year)	3 years/1 year Included (1 year)

small (the norm here was about 3GB) but earned the HWS-5200MX an above-average score on our Disk WinMark 97 test. An 8X Matsushita CD-ROM drive contributed to the one blight on the system's record: a below-average CD-ROM WinMark 97 score. All other scores on our tests were average.

The unit is based on an Intel motherboard and Intel's 430HX chip set. Graphics were provided by a Matrox Millennium adapter. The NEC Multi-Sync M700 monitor featured built-in speakers—an attractive office space saver—that, combined with the integrated Yamaha audio chip set, produced tolerable sound.

Hymco covers the system with a two-

year warranty. Technical support is limited to business hours on weekdays.

The HWS-5200MX offers average performance and well-known components, but you may find a better value for your dollar elsewhere.—*MEB*

HWS-5200MX. Direct price: \$3,299. Hymco Technologies Inc., San Jose, CA; 800-884-9626, 408-251-6888; fax, 408-251-2333; www.hymco.com. **Circle 465 on reader service card.**

IBM Personal Computer Co.

IBM PC350

When you think corporate desktop, IBM likely comes to mind. The IBM PC350 (\$4,000 street) offers all you'd expect in a serious business PC—including network-readiness, manageability, and security features—and it still accepts legacy hardware and provides a stable platform. Its benchmark test performance kept pace with this speedy group.

The PC350 supports IBM's Wake-on-LAN technology, which allows remote access for MIS functions. Wake on LAN needs three components: an enabled motherboard (included), an enabled network card (a \$120 option, available in Ethernet or Token-Ring), and the client version of IBM's TME 10 NetFinity 4.0 network management software (included). NetFinity is one of the few DMI implementations in this roundup that provides a 32-bit service layer, so a network administrator can monitor the PC350's assets remotely.

The PC350 offers prodigious security features, from a lock on the front cover to passwords that allow network administrators to restrict access to certain PC components as well as to software. This latter feature makes it impossible for others to change configuration or setup settings.

IBM PCs have been in corporations since the beginning of the PC age, and with the IBM PC350, this vendor demonstrates that it intends its systems to stay there for many years to come.—*MEB*

IBM PC350. Street price: \$4,000. IBM Personal Computer Co., Armonk, NY; 800-426-4968; fax, 800-426-4329; www.pc.ibm.com. **Circle 466 on reader service card.**

Intergraph Computer Systems

Intergraph TD-25

After cutting its teeth in the Unix workstation and digital animation markets, Intergraph Computer Systems is now selling mainstream PCs. Its Intergraph TD-25 (\$2,940 street) is a well-crafted PC with an adept graphics subsystem.

At first glance, this tool-free ATX mini-tower does not seem to have any external drives. But open a swinging door with a key lock and you'll find the floppy disk drive, CD-ROM drive, and two 5.25-inch bays. A single available 3.5-inch bay resides within the chassis.

Though it is partially obstructed by cables, an open DIMM slot allows for memory upgrades, limited to 64MB of SDRAM. Intel's new 430TX chip set is present, as is a Matrox Millennium graphics card, which helped the system achieve an above-average score on our Graphics WinMark 97 tests.

A PCI audio card connects to the system's ConcertMaster Multimedia keyboard, which integrates SRS 3-D stereo speakers, a microphone, a subwoofer jack, and a headphone jack. With such an unobtrusive audio solution and a graphics solution that achieves 1,152-by-864 resolution with 32-bit color at a 75-Hz refresh rate, the Intergraph TD-25 offers affordable yet proficient multimedia.—*CM*

Intergraph TD-25. Street price: \$2,940. Intergraph Computer Systems, Huntsville, AL; 800-692-8069; fax, 205-730-6188; www.intergraph.com. **Circle 467 on reader service card.**

Kingdom Computers

Kingdom Pentium MMX 200 Value

Kingdom Computers takes pride in its service and support policy. The policy isn't unprecedented, but it is certainly generous, and it is a primary selling point of the Kingdom Pentium MMX 200 Value PC (\$2,397 direct).

The unit's mini-tower has an unusual internal design: It is segmented into three parts. A 3GB Quantum Fireball hard disk and the floppy disk drive reside on a shelf at the top of the system. Tethered cables from the two drives run through an opening in this shelf, through the rather empty middle

section of the machine, and through a second opening to a Baby AT motherboard in the third section. The motherboard provides one DIMM slot, which holds a maximum of 96MB of SDRAM, and four SIMM slots, which are hidden behind one of three unused 3.5-inch internal drive bays.

For an unusually low price, Kingdom includes a 16X CD-ROM drive, a tool-free chassis, a copy of Lotus SmartSuite, and a three-year warranty with a year of on-site service. Though the company offers only 13 hours of technical assistance on weekdays (8 hours on Saturday, none on Sunday), its entire service and support package is indeed attractive.—*CM*

Kingdom Pentium MMX 200 Value. Direct price: \$2,397. Kingdom Computers, Mansfield, PA; 800-385-3436, 717-662-7515; fax, 717-662-3875; www.kingdom-computers.com. *Circle 468 on reader service card.*

Magitronic Technology Inc.

Magitronic G-P200MX

The Magitronic G-P200MX, from Magitronic Technology, distinguishes itself not with hardware but with software. Though this machine (\$3,000 street) is priced higher than many PCs here, it offers average performance and ships with Lotus SmartSuite and several reference titles.

This midtower is equipped with two DIMM slots and four SIMM slots, which support up to 512MB of RAM. The slots are fairly difficult to access, however: An unused 3.5-inch drive bay hangs down in front of them. The system's Baby AT motherboard offers two open ISA slots and three open PCI slots, but two were unusable as configured: An ISA slot is obstructed by the system's parallel port, while a PCI slot is obstructed by the serial port.

Though the machine we tested had a 2.4GB Seagate Fast ATA-2 hard disk and lacked a modem, Magitronic is now shipping the unit with a 3.1GB Western Digital hard disk and a U.S. Robotics 33.6/

14.4-Kbps modem. In addition to SmartSuite, the company also includes the 1997 Grolier Encyclopedia, a World Atlas package, and several edutainment titles.

The Magitronic G-P200MX will get the job done and adds some good software to boot, but don't expect service or expansion to be easy.—*CM*

Magitronic G-P200MX. Street price: \$3,000. Magitronic Technology Inc., Irvine, CA; 714-727-1243; fax, 714-727-3765; www.magitronic.com. *Circle 469 on reader service card.*

Maximus Computers Inc.

Magna Media

You can now watch "General Hospital" at the office. Maximus Computers' Magna Media (\$2,399 direct) ships with an ATI All-in-Wonder graphics card that integrates—among other things—a TV tuner (antenna not included). Maximus also bundles a 33.6/14.4-Kbps modem and Lotus SmartSuite with the unit, as well as a spacious 4.8GB hard disk.

The system's SuperMicro Baby AT motherboard features 512K of secondary cache. With one ISA slot housing the modem and another the Addonics sound card, two are available for expansion. There are also three unused PCI slots, but I/O ports block two of them. The fourth

this roundup, leading to a below-average score on our Graphics WinMark 97 tests. The unit got an above-average Disk WinMark 97 score, however; all other scores were average.

Even if you're not interested in PC presentations or TV access, the Magna Media is an attractive option.—*CM*

Magna Media. Direct price: \$2,399. Maximus Computers Inc., Irwindale, CA; 800-888-6294; fax, 818-969-2775; www.maximuspc.com. *Circle 470 on reader service card.*

Mega Computer Systems

Impact Pentium/MMX200

The Impact Pentium/MMX200 (\$3,500 direct) ranks just below the top tier of corporate MMX systems. Though nicely equipped, it lacks system management and security features.

The Impact ships with 32MB of SDRAM plugged into a pair of DIMM slots; it can accommodate EDO DRAM in its four additional SIMM sockets. The SIMMs, however, are difficult to access.

A Diamond Stealth 3D 3000 card contributed to an above-average Business Graphics WinMark 97 score; a PCI-to-Ultra SCSI adapter and a 4.2GB 7,200-rpm Quantum Ultra Wide SCSI-3 hard disk led to an above-average Business Disk WinMark 97 score. The unit's Business Winstone 97 score was average.

With a 33.6/14.4-Kbps modem and a Creative Labs Sound Blaster AWE64 sound card, there are no open dedicated ISA slots; one PCI slot and one shared slot remain open. The vendor includes the Microsoft Natural Keyboard and Cheyenne Communications' modem software Bitware.

The Impact makes an impact—albeit a tempered one—by combining brisk graphics with capable disk-based abilities.—*CM*

Impact Pentium/MMX200. Direct price: \$3,500. Mega Computer Systems, San Diego; 800-338-6628, 619-487-8888; fax, 619-485-1518; www.megacs.com. *Circle 471 on reader service card.*



Kingdom Pentium MMX 200 Value, Magitronic G-P200MX.

PCI slot contains the ATI All-In-Wonder graphics card, which integrates a TV tuner, a video-capture engine, and an NTSC/PAL/S-Video-out connector (for viewing presentations on a TV).

The graphics card is extremely functional but could not keep up with others in

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Micro Express

MicroFlex-MMX/200

Although aimed at multimedia users, the MicroFlex-MMX/200 (\$2,599 direct), from Micro Express, did not post strong graphics or CD-ROM test scores. However, it did deftly handle our disk-intensive tests using a PCI-to-SCSI controller and SCSI hard disk.

BCM Advanced Research's Baby AT motherboard integrates four SIMM slots just above the two occupied DIMM sockets. There are only two available expansion slots, because of the included Apache Cyberpower 33.6/14.4-Kbps modem and 16MB CMD caching disk controller. The latter—together with a 2.1GB Quantum Fast/Wide SCSI-2 hard disk—helped produce a top-ten Business Winstone 97 score and a Business Disk WinMark 97 score that was well above average.

Though this midtower machine has no open internal drive bays, it has an empty front-accessible 3.5-inch bay and two empty front-accessible 5.25-inch bays. Micro Express includes Cheyenne Communications' Bitware package.

The affordable MicroFlex is a good choice for users running database applications or other disk-intensive tasks.—*CM*
MicroFlex-MMX/200. Direct price: \$2,599. Micro Express, Irvine, CA; 800-989-9900, 714-852-1400; fax, 714-852-1225; www.microexpress.net. Circle 472 on reader service card.

Micron Electronics Inc.

Millennia MME P200

Continuing its tradition of providing affordable cutting-edge PCs, Micron Electronics offers its Millennia MME P200 (\$2,418 direct), with Intel's new 430TX chip set and a 3GB Quantum Stratus Ultra DMA-33 hard disk. The Millennia was one of the best overall performers in this roundup. (For larger business installations that demand manageability features, Micron offers its ClientPro line of

PCs. These machines include Intel's LAN-Desk Client and Fast Ethernet adapters. ClientPro PCs are also available with Intel's new Pentium II processor.)

On our Business Graphics WinMark 97 tests, the Millennia posted a score of 100—41 percent above average, and 14



points ahead of its next-closest competitor (although it did have a bit of help from GDI bypassing; with bypassing turned off, the score dropped to 85).

The Millennia also offers two USB connectors, integrated Yamaha surround sound, Advent AV270 speakers, and a 16X CD-ROM drive. Micron provides an Iomega Zip drive with a 100MB cartridge, a tool-free chassis, Microsoft Office 97, and several MMX titles, including Adobe PhotoDeluxe.

The Micron Millennia MME P200 is a well-stocked, attractively priced PC.—*CM*
Millennia MME P200. Direct price: \$2,418. Micron Electronics Inc., Nampa, ID; 888-634-8799, 208-893-3343; fax, 208-893-3424; www.micronpc.com. Circle 473 on reader service card.

Microniche Information Systems

Microniche MIS-55PM

In this roundup of business-oriented PCs, the Microniche MIS-55PM (\$2,499 direct) appears decidedly unbusinesslike. With features such as an Orchid Righteous 3D accelerator and a bundled copy of MechWarrior 2, this PC may be better suited to home users.

The MIS-55PM ships with fast-page-mode DRAM rather than the pervasive and more adept EDO DRAM or SDRAM.

The four SIMM slots are easy to access: This midtower's cables, running from the ATX motherboard to the various drives, are tethered and kept out of the way.

The MIS-55PM includes two expansion cards: a Matrox Millennium graphics card and the Orchid Righteous 3D accelerator, which produces dazzling 3D graphics. An audio subsystem is integrated.

This system turned in mostly average test scores; it posted below-average scores on our CPUmark₃₂ and CD-ROM WinMark 97 tests because of its 8X CD-ROM drive.

The MIS-55PM's price and fair performance may keep it under consideration—but most likely not for business buyers.—*CM*

Microniche MIS-55PM. Direct price: \$2,499. Microniche Information Systems, Fremont, CA; 800-733-9188, 510-226-9188; fax, 510-226-0230; www.microniche.com. Circle 474 on reader service card.

Micro X

Micro X MXP-5000

Micro X, the new systems division of Micro Xperts, makes its debut in *PC Magazine* with the Micro X MXP-5000 (\$3,379 direct). For the higher price you get more hardware than average and a good warranty.

The MXP-5000 offers Intel's new chip set, the 430TX. The unit came with a 4.1GB Quantum Ultra Wide SCSI hard disk; by the time you read this, Ultra ATA hard disks will be available.

In a nod toward the future, the memory offering is a 32MB SDRAM DIMM stick; the motherboard also supports SIMMs. More new technology includes two USB connectors and a DMI-enabled BIOS. The system has a 33.6/14.4-Kbps modem, a Matrox Millennium graphics card with 8MB of WRAM, and a 16X CD-ROM drive.

The MXP-5000 performed well on our tests. Most results were average, with one exception: an above-average score on our Business Disk WinMark 97 test, thanks to its 7,200-rpm SCSI hard disk.



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Micro X backs the system with an exceptional warranty: three years on parts, five years on labor, including one year of on-site service. The strong warranty, good performance, and forward-looking technology make this a system to consider.—*MEB*

Micro X MXP-5000. Direct price: \$3,379. Micro X, Solon, OH; 800-215-5214, 216-498-3330; fax, 216-498-3520; www.microx.com. *Circle 475 on reader service card.*

MidWest Micro

MidWest Micro MWO-200-X Office PC

MidWest Micro caters to both the home and business markets, and the MidWest Micro MWO-200-X Office PC (\$2,799 direct) straddles the line. It's meant as a business PC, but the unit offers more online support and bundled software than some home PCs, as well as some impressive video-output options (although at the expense of business graphics application performance).

Using this unit for large-screen presentations is easy; its ATI 3D Pro Turbo PC2TV graphics board includes the port and cables you need to send video output to a TV or VCR. However, it was also responsible for the system's extremely poor Business Graphics WinMark 97 score (tied for last place in this roundup).

The machine also included a 4GB IBM hard disk, a Mitsumi 16X Max CD-ROM drive, a Boca Research 33.6-Kbps voice modem with QuickLink Message Center data/fax/voice software, and a Creative Labs Sound Blaster AWE32 wavetable sound board (the AWE64 board will be standard by the time you read this).

If you're looking for a well-equipped, affordable PC with a useful video twist, this machine is a good bet.—*RSA*

MidWest Micro MWO-200-X Office PC. Direct price: \$2,799. MidWest Micro, Fletcher, OH; 800-728-8582, 937-368-2309; fax, 937-368-2306; www.mwmicro.com. *Circle 476 on reader service card.*

Mitsuba Corp.

Premier System-200MMX

The Premier System-200MMX (\$2,900 street), from Mitsuba Corp., is an adequate choice as a power business PC, with average performance and an easy-to-service case.

Mitsuba custom builds PCs with an eye toward serviceability and upgradeability. The Premier System-200MMX comes in a tool-free midtower case and offers six empty drive bays (three 5.25-inch and three 3.5-inch bays). The drives are mounted on rails and snap in and out of their bays easily, which will make swapping out drives or adding new fixed devices a painless procedure.

Using a 2.4GB Maxtor hard disk and an STB 3D Velocity graphics board with



NMC Expert+MMX200, Mitsuba Premier System-200MMX.

8MB of VRAM, the Premier System-200MMX posted average scores across our tests with one highlight: an above-average Business Disk WinMark 97 result, thanks to its 5,400-rpm ATA-3 disk.

Audio hardware included a Creative Labs Sound Blaster AWE32 wavetable sound board and a set of Cambridge SoundWorks bookshelf speakers. The unit came without application software but was bundled with a Hyundai Deluxe Scan 17-inch monitor.

A good set of components and competitive performance make this system worthy of consideration.—*RSA*

Premier System-200MMX. Street price: \$2,900. Mitsuba Corp., LaVerne, CA; 800-648-7822, 909-392-2000; fax, 909-392-2021; www.mitsuba.com. *Circle 477 on reader service card.*

National Microcomputers Inc.

Expert+MMX200

The Expert+MMX200 (\$2,395 direct), from National Microcomputers—offering average performance and a good sound system—is targeted mostly at SOHO buyers.

The midtower's case opens easily after the removal of a thumbscrew, but the DIMM slots are partially blocked by cables. The unit included Altec Lansing ACS45 speakers with subwoofer and a 32-bit Creative Labs AWE32 wavetable sound board. The unit's ASUSTek motherboard offers a Media Bus 2.0 extension on one of the PCI slots, which allows it to use an ASUSTek graphics/audio board (not sent with the tested system).

With an installed Matrox Mystique graphics board with 4MB of SGRAM and a 2.9GB Western Digital hard disk, the unit earned average scores on all of our tests.

The Expert+MMX200 came with a number of home-oriented CD-ROM titles, including Microsoft Encarta 96, Microsoft Explorapedia, and Microsoft Works, as well as a U.S. Robotics Sportster 33.6/14.4-Kbps data/fax modem. The system is not DMI-compliant.

An attractive price, a top sound system, and average performance make this unit worthy of consideration if manageability isn't a priority.—*RSA*

Expert+MMX200. Street price: \$2,395. National Microcomputers Inc., Murray, UT; 800-800-4662, 801-265-3700; fax, 801-265-3783; www.natmicro.com. *Circle 478 on reader service card.*

Nova Computers Inc.

Nova P55-200MMX

The Nova P55-200MMX PC (\$2,549 direct), from Nova Computers, offers a few compelling extras—such as an ergonomic keyboard with a built-in touch pad—as well as fair performance, for the price.

This unit's ASUSTek motherboard is based on Intel's 430HX chip set; Nova



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Computers said systems with Intel's new 430TX chip set would be available by the time you read this. The motherboard also includes a PCI slot with a Media Bus 2.0 extension, which can support an ASUSTek graphics/audio card or any PCI device. The unit offered plenty of expansion room with six open drive bays.

Using competent components such as a 3GB Quantum Fireball hard disk and a Diamond Stealth 3D 2000 graphics card with an S3 ViRGE chip set and 4MB of EDO DRAM, the Nova unit managed test results that fell within the average range.

The Nova PC had an ergonomic keyboard with a touch pad and a convenient pass-through mouse port. The Creative Labs Sound Blaster AWE32 audio card in our test unit was upgraded to an AWE64 at no extra cost.

This machine covers all the bases at a price that's affordable.—RSA

Nova P55-200MMX. Direct price: \$2,549. Nova Computers Inc., Wickliffe, OH; 800-461-5535, 216-516-3030; fax, 216-516-3040; www.novacompcinc.com. *Circle 479 on reader service card.*

Polywell Computers Inc.

Poly 5200Tx8

Polywell Computers' Poly 5200Tx8 (\$2,750 direct) shows that top components pay off. Polywell targets the higher-performance business and home-office markets, and it provides a fast PC with a generous warranty and a fair price.

The system's Intel 430TX chip set gets some credit for its high performance scores, along with its 512K of L2 cache and 4.8GB 5,400-rpm ATA-3 Maxtor hard disk. With some of the best scores we saw on our CPU, Disk WinMark 97, and Winstone 97 tests, the unit ranks among this roundup's leaders. Using a Matrox Millennium graphics adapter, it received an average Graphics WinMark 97 score.

There is a single available IRQ for further expansion, as well as two DMA channels. In addition to a 33.6/14.4-Kbps

modem, the Poly 5200Tx8 comes with a high-quality 16-inch, 0.26-dot-pitch iiyama monitor. The company offers technical support round-the-clock for the first year (and during business hours thereafter) and provides a warranty lasting three years for parts and five years for labor, including first-year on-site service.

The good support policies, strong performance, and fair price make this PC an attractive choice.—BB

Poly 5200Tx8. Direct price: \$2,750. Polywell Computers Inc., South San Francisco; 800-999-1278, 415-583-7222; fax, 415-583-1974; www.polywell.com. *Circle 480 on reader service card.*

Premio Computer Inc.

Premio TX-P200M

Premio Computer's Premio TX-P200M (\$2,610 street) boasts two USB ports, Intel's new 430TX chip set, and PC-to-TV video, but it exhibited poor graphics performance on our tests. Although its price is moderate for the field, mainstream corporate users might want to bypass the presentation video card for better system-level graphics performance with a different card.

The Premio PC is configured with an ATI 3D Pro Turbo PC2TV card with 4MB of SDRAM, which lets you hook up the PC to a TV for presentations via composite video or S-Video. This setup's downside was a below-average Graphics WinMark 97 score, which dragged the Winstone 97 score to below-average as well. But the 7,200-rpm Quantum Atlas II 4.2GB Ultra Wide SCSI-3 hard disk



and Adaptec Ultra Wide controller led to an above-average Disk WinMark 97 score.

This machine has no available IRQs, so when it comes time to add another device, system configuration could be difficult. Premio's three-year parts-and-labor warranty can be upgraded to include on-site service for \$50 per year.

The Premio TX-P200M incorporates several new technologies, but

graphics performance and upgradability suffer.—BB

Premio TX-P200M. Street price: \$2,610. Premio Computer Inc., City of Industry, CA; 800-677-6477, 818-333-5121; fax, 818-369-6803; www.premiopc.com. *Circle 481 on reader service card.*

ProGen Systems

Atlas X-200

Buyers will find a good value in ProGen Systems' Atlas X-200 (\$2,229 direct). The system has fine standard components, a low price, and strong overall performance, highlighted by especially good graphics performance.

Equipped with Intel's 430VX chip set and with 512K of L2 cache, this computer posted average scores on all of our tests except Graphics WinMark 97 and CD-ROM WinMark 97. Courtesy of its Matrox Millennium graphics adapter with 4MB of WRAM and its Sony 16X CD-ROM drive, the Atlas X-200 turned in above-average scores on both of those test suites.

The system provides a single available IRQ as well as two free DMA channels, five open drive bays, and three slots that can hold full-length ISA cards. It also comes with a 33.6/14.4-Kbps modem and speakers with subwoofer.

Employing standard high-powered components, the Atlas X-200 is a good value.—BB

Atlas X-200. Direct price: \$2,229. ProGen Systems, Tustin, CA; 800-848-1353, 714-566-9200; fax, 714-566-9267; www.progen.com. *Circle 482 on reader service card.*



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Quantex Microsystems

Quantex QP5/200 SM-3X

Quantex Microsystems packs a lot of value into the Quantex QP5/200 SM-3X (\$2,999 direct). A mostly midrange performer with plenty of expansion space and good components, this system is a reasonable purchase choice.

The Quantex PC has room for five more drives, two more ISA cards, and two PCI cards. It has three available DMA channels, but if you install a network card (as we did), it will have no available IRQs.

The unit owes its above-average disk performance to a 4GB Seagate Ultra Wide SCSI hard disk with an Adaptec Ultra Wide SCSI controller. Most other test results were average, except for the Graphics WinMark 97 score, which was below average despite the Matrox Millennium graphics adapter with 4MB of WRAM.

The unit also has an Ensoniq wavetable audio card, Altec Lansing speakers with subwoofer, a 33.6/14.4-Kbps modem, and a selection of software that includes Corel's WordPerfect Suite and some helpful utility and reference applications.

The system's full set of hardware, usable software, and good performance make it worthy of a second look.—BB

Quantex QP5/200 SM-3X. Direct price: \$2,999. Quantex Microsystems, Somerset, NJ; 800-346-6572, 908-563-4166; fax, 908-563-0407; www.quantex.com. *Circle 483 on reader service card.*

Reason Technology Inc.

Square One HO/M-200

The Square One HO/M-200 (\$3,395 direct), from Reason Technology, is a fast, well-equipped PC with some of this roundup's highest test scores. Add a six-year warranty and you have a powerhouse worth the higher-than-average price.

A tool-free chassis encases this minitower. The unit has two DIMM slots (one is fairly difficult to reach, since it is close to the power supply), and it integrates six

unused SIMM slots. Although two USB ports connect out via a backplate for one of the PCI slots, other slots are available.

The system's Winstone score was tied for the roundup's best—in part because of an Adaptec SCSI controller and a 4.2GB

hard disk, helped it achieve the group's fourth-highest Disk WinMark 97 score. Its 12X/16X CD-ROM drive managed the roundup's number-two CD-ROM WinMark 97 score; other scores were average.

The system comes with Cambridge

SoundWorks speakers and a subwoofer, as well as a Cirque ergonomic keyboard with a touch pad pointing device. Royal also bundles good software: Microsoft Office 97, Quicken SE, Compton's Interactive Encyclopedia, VocalTec's Internet Phone, and IBM's VoiceType Navigator.

With such software and an abundance of proficient hardware, the Power Graph UW justifies its cost.—CM

Power Graph UW. Direct price: \$3,995. Royal Computer Inc., City of Industry, CA; 800-486-0008, 818-855-5077; fax, 818-330-2717; www.royalcomp.com. *Circle 485 on reader service card.*

SAG Electronics

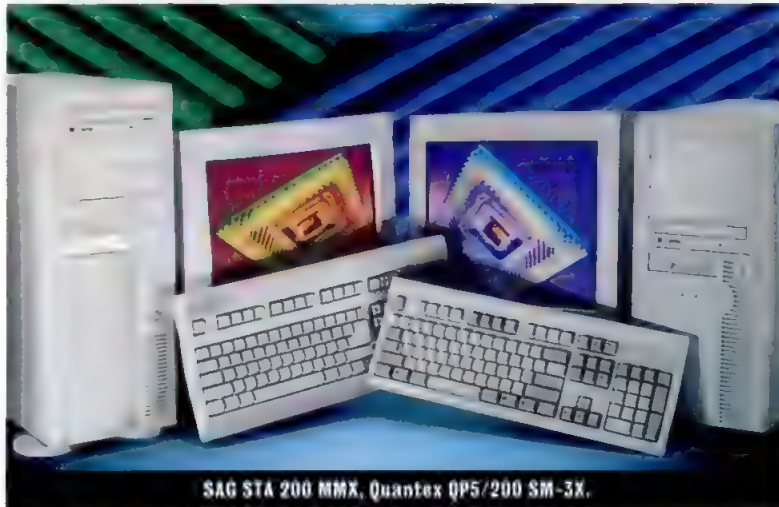
SAG STA 200 MMX

The centerpiece of SAG Electronics' SAG STA 200 MMX (\$3,330 direct) is its 10,000-rpm hard disk. Like most of the roundup's SCSI-equipped machines, this PC scored unusually high on our Disk WinMark 97 tests and earned one of the roundup's highest Winstone 97 results.

This midtower's motherboard has two USB ports and integrated Yamaha sound. The two ISA slots and single shared slot are unused; two of the three PCI slots hold a Number Nine 9FX Reality 772 graphics board and an Adaptec Ultra Wide disk controller, which runs the 4.2GB Seagate Cheetah Ultra Wide SCSI hard disk.

The fast disk helped the unit perform 50 percent above the mean on Disk WinMark, with one of the top three scores. This result buoyed the Winstone score into the top ten as well; other scores were average.

The Princeton monitor had difficulty running at high resolutions and color depths. Since 1,024-by-768 resolution at 16-bit color is adequate for most business use, however, this should not be a big prob-



10,000-rpm Seagate Ultra Wide SCSI hard disk, which also delivered this roundup's second-highest Disk WinMark 97 score. Supporting hardware includes Intel's 430TX chip set and a Hercules Terminator 3D graphics card, which led to an above-average Graphics WinMark 97 score.

The Square One backs up this admirable performance with a lengthy if complex warranty: six years for labor and three to six years for parts, depending on the part. This PC is definitely a contender.—CM

Square One HO/M-200. Direct price: \$3,395. Reason Technology Inc., Coon Rapids, MN; 800-800-4860, 612-780-4792; fax, 612-780-4797; www.reasontech.com. *Circle 484 on reader service card.*

Royal Computer Inc.

Power Graph UW

Royal Computer's Power Graph UW (\$3,995 direct) is more expensive than most of this roundup's PCs, but it ships with a 33.6/14.4-Kbps modem, a generous software bundle, a fast CD-ROM drive, and an even faster hard disk.

The system has one DIMM slot and four SIMM slots; you can use all five at once (for up to 128MB of memory). One PCI slot and one shared slot were free.

The unit's disk subsystem, an Adaptec Ultra Wide SCSI controller connected to a 10,000-rpm Seagate Ultra Wide SCSI



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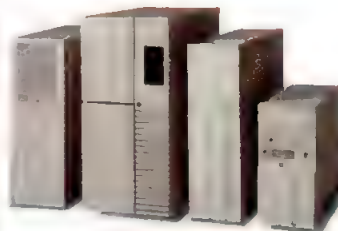
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lem. Other tested PCs with this monitor had similar trouble.

If you need a blazingly fast disk subsystem, SAG has a machine for you.—*CM*
SAG STA 200 MMX. Direct price: \$3,330. SAG Electronics, North Andover, MA; 800-989-3475, 508-683-0339; fax, 508-689-0180; www.sagelec.com. *Circle 486 on reader service card.*

Seanix USA

Seanix CS Plus 200

Seanix USA, whose PCs are manufactured in Iowa by Canadian vendor Seanix Technology, is a new direct sales division that sells only in the United States. Its Seanix CS Plus 200 (\$2,499 direct) can serve as either mini-tower or desktop.

The Seanix PC resembles a standard, off-white mini-tower. Yet you can lay it flat on the desktop by removing the side and front panels, and by rotating by 90 degrees the metal cage housing the CD-ROM drive and two empty 5.25-inch front-accessible bays. Thus, the CD-ROM drive becomes suitably parallel to the floor. This unit also features two integrated USB ports. The motherboard has Intel's 430TX chip set, four unused card slots, and two DIMM slots that support SDRAM.

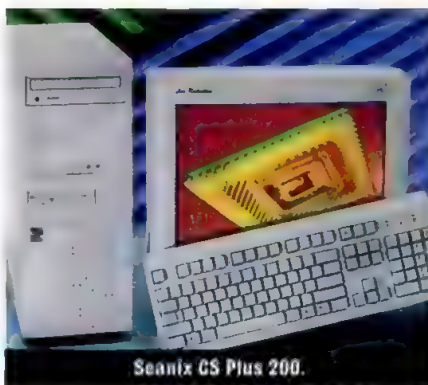
A 3.7GB EIDE hard disk contributed to an average Disk WinMark 97 result. During informal testing, the system's Matrox Mystique card exhibited particularly clear and comfortable graphics at 1,024-by-768 resolution, although the Graphics WinMark 97 score was below average.

The unit is a typical performer with typical hardware, but its flexible design is decidedly unusual—and beneficial.—*CM*
Seanix CS Plus 200. Direct price: \$2,499. Seanix USA, Sioux City, IA; 888-252-1190, 712-255-3733; fax, 712-233-3278; www.seanix.com. *Circle 487 on reader service card.*

STD Systems Inc.

Compupartner MMX5-200

Ontario-based STD Systems has entered the corporate MMX Pentium market with the Compupartner MMX5-200 (\$2,500 street), a mini-tower PC whose leading characteristic is its price. It was an anemic performer, though, and its poor internal design not



only wastes space but will cause headaches when it's time to upgrade.

The hard disk occupies one of two 3.5-inch front-accessible bays—unnecessarily, as there are three unused internal bays. Also, even though there are cutouts in the case, the parallel port uses the top PCI slot's backplate. Though these situations are easily fixed, they are an annoyance that end users shouldn't have to experience.

To compound matters, the awkwardly placed hard disk led to our roundup's lowest Disk WinMark 97 score. Running at a 5,200-rpm rotational speed, it was left in the dust by other machines' much faster devices. The Graphics WinMark and Winstone results were also below average.

Unfortunately for the Compupartner, a low price may not make up for poor performance and design when other PCs are faster, are better laid out, and are the same price or cheaper.—*CM*

Compupartner MMX5-200. Street price: \$2,500. STD Systems Inc., Markham, Ontario, Canada; 905-477-0388; fax, 905-477-0117; www.std.net. *Circle 488 on reader service card.*

Summit Micro Design Inc.

Mount Shasta MMX

The Mount Shasta MMX (\$2,595 direct), from Summit Micro Design, offers good features and strong performance at an attractive price.

Business users will like the Fast Ethernet adapter and Intel LANdesk Client Manager, both included in this midtower PC. The unit also boasts an integrated chip set that works with its BIOS and LANdesk to monitor system status and temperature and to give failure alerts.

The 2.4GB hard disk is smaller than most we saw, but this 5,400-rpm ATA-3

disk helped the unit to an above-average result on our Disk WinMark 97 tests. The Graphics WinMark 97 score was also above average. Other scores were average.

The power switch is in the back of the unit, but there's a soft power-down/sleep-mode switch in front that lets you power up and down without rebooting. The test unit also came with a CyberVision monitor, which is capable of 1,600-by-1,200 resolution, and picture quality was good.

Good performance coupled with a low price make this manageable PC an attractive buy.—*Alfred Poor*

Mount Shasta MMX. Direct price: \$2,595. Summit Micro Design Inc., Sunnyvale, CA; 800-288-5828, 408-739-6348; fax, 408-739-4643; www.smd-hq.com. *Circle 489 on reader service card.*

Supercom

Touch MMX200-210

Supercom's Touch MMX200-210 has an appealing price (\$2,530 street) and makes itself even more attractive by adding decent performance and a good sound subsystem to the mix. This vendor began making PCs in 1983 but then scaled down to distributing components and peripherals with a smaller custom-PC base. In 1995, the company resumed building and selling systems in quantity.

The Touch MMX200-210's motherboard was equipped with Intel's new 430TX chip set and EDO DRAM (the motherboard also accepts SDRAM). Our unit's 5,400-rpm 2GB hard disk was small for this test group, but it got the job done. All benchmark test results were average.

Other hardware shipped with the system includes a 16X CD-ROM drive and a pair of Nakamichi speakers plus subwoofer, which have a surround-sound synthesis feature but no tone control. A 33.6/14.4-Kbps fax modem is included, but there is no network adapter; also, the system is not DMI-compliant. The case has an ample number of drive bays and slots for expansion.

A good price, acceptable performance, and an above-average sound system make this product worthwhile. Take a look.—*AP*
Touch MMX200-210. Street price: \$2,530. Supercom, Milpitas, CA; 800-888-1888, 408-456-8888; fax, 408-263-1234; www.supercom.com. *Circle 490 on reader service card.*

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Source: PC World best overall PC company for reliability and service, December 1996.

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Sys Technology Inc.

Sys Performance P200T2M

The Sys Performance P200T2M (\$2,598 direct), from Sys Technology, was an exceptional performer in the graphics arena as well as an average one on our other tests. This makes it a good choice for those seeking speed at a bargain price.

The PC's Baby-AT motherboard, manufactured by GigaByte, uses Intel's 430HX chip set. Also featured is a Diamond Stealth 3D 3000 graphics board, which was able to drive the system to the second-best Graphics WinMark score of this roundup. The unit's monitor (made by KDS for Sys) handles even 1,600-by-1,200 resolution images well.

Expansion options are fairly good here, with ready access to SIMM slots and five drive bays. The IDE and floppy disk drive's Clutter-Free data cables are designed to eliminate the tangle you get with standard ribbon cables. Sys Technology completes the package with a 12X TEAC CD-ROM drive, Cardinal 33.6/14.4-Kbps data/fax modem, Creative Labs Sound Blaster 32 audio board, and speakers.

The Sys Performance P200T2M is worth a look. It offers top graphics performance for an attractive price.—AP

Sys Performance P200T2M. Direct price: \$2,598. Sys Technology Inc., Cypress, CA; 800-613-9963, 714-821-3900; fax, 714-821-9592; www.systechology.com. *Circle 491 on reader service card.*

Tagram System Corp.

Thunderbolt MXL 200

The Thunderbolt MXL 200 (\$3,265 direct) has a slightly higher price than the typical direct-channel systems we looked at for this roundup. But there's a payoff: This PC was an outstanding performer on our benchmark tests.

The machine's ATX-style motherboard came with Intel's 430TX chip set. Besides a top-notch Winstone score (tied

for first place with two others), our unit also ranked first on the Disk WinMark 97 and CD-ROM WinMark 97 tests. The Graphics WinMark 97 score was also above average.

The Thunderbolt story isn't just about speed, however. This PC's biggest component is mainly responsible for its great performance: a 4.2GB 10,000-rpm Ultra Wide SCSI hard disk. Also featured is a



16X Toshiba CD-ROM drive with a SCSI interface and a pair of USB ports. There are a few weak spots in this system, though, such as the tinny-sounding QuickShot speakers (we suggest an upgrade). Additionally, the audio cable from the CD-ROM drive in our unit either came loose in shipping or was not connected in the first place.

But is it speed and capacity you want? Then Tagram's Thunderbolt is a straight shot into the fast lane.—AP

Thunderbolt MXL 200. Direct price: \$3,265. Tagram System Corp., Costa Mesa, CA; 800-824-7267, 714-979-8900; fax, 714-979-8970; www.tagram.com. *Circle 492 on reader service card.*

Tangent Computer Inc.

Tangent 5200M

The Tangent 5200M (\$2,395 direct), from Tangent Computer, offers a typical configuration that posted average scores on our benchmark tests. Backed by a three-year warranty, it's quite a reasonable value.

The product's midsize tower houses an ATX motherboard with Intel's new 430TX chip set and synchronous DRAM

memory. The motherboard also offers six SIMM slots. This system scored in the average range on all of our benchmark tests.

The 5200M's hardware list includes a 3GB IBM Deskstar hard disk, a 12X Toshiba CD-ROM drive, and a 17-inch CTX monitor. This system also features a Creative Labs Sound Blaster 32 PnP audio card and a pair of inexpensive yet adequate speakers by Fudin.

The Intel-manufactured case is easy to open. Once inside, you immediately notice that the two USB connectors are blocking a PCI slot. But since there are plenty of free slots, this isn't a serious obstacle to powerful computing. The ISA slots can accept full-length legacy cards, and there are also three free external drive bays.

Tangent offers a healthy three-year warranty covering parts and

labor, which includes on-site service for the first year. Ultimately, the Tangent 5200M offers middling configuration and performance at a competitive price.—AP
Tangent 5200M. Direct price: \$2,395. Tangent Computer Inc., Burlingame, CA; 800-342-9388, 415-342-9388; fax, 415-342-9380; www.tangent.com. *Circle 493 on reader service card.*

Toshiba America Information Systems Inc.

Equium 5200D

The Equium 5200D (\$2,900 street) marks Toshiba's entry into the business desktop market. This DMI-compliant PC is not designed for speed; rather, it's meant to be a manageable solution for large corporate installations. On that front, it succeeds.

To manage the Equium, Toshiba includes Intel's LANdesk Client Manager 3.0 and a 32-bit service layer for remote management. The Equium's LPX-style motherboard also has temperature and voltage sensors, as well as a chassis-intrusion alert feature. The motherboard integrates an ATI 3D Rage II graphics accelerator chip set with 4MB of SGRAM. Also featured are an integrat-

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ed Intel EtherExpress PRO/100B Fast Ethernet adapter, 16-bit audio, and two USB ports. The case's power switch is located in the back, but there is a handy sleep switch on the front, which permits a soft power-down and start-up without rebooting.

The Equium performed fairly well on our tests. Using a 2.4GB 5,400-rpm Fast ATA-3 Maxtor hard disk, it earned an above-average Disk WinMark 97 score. All other scores were average except for the Graphics WinMark 97 score, which was below average.

If you want a highly integrated, network-ready, manageable solution, the Equium 5200D is a slimline desktop worthy of your consideration.—AP

Equium 5200D. Street price: \$2,900. Toshiba America Information Systems Inc., Irvine, CA; 800-457-7777, 714-583-3000; fax, 714-461-9027; www.equium.toshiba.com. Circle 494 on reader service card.

Total Peripherals Inc.

Archer-2000

The Archer-2000 (\$3,199 direct), from Total Peripherals, costs a little more than the norm for this roundup. The unit is packed, however, with good components, and it performs well—two factors increasing its appeal.

The system's ATX motherboard uses two leading-edge components: synchronous DRAM and Intel's new 430TX core-logic chip set. An Adaptec Ultra Wide SCSI adapter drives the 4GB 7,200-rpm Seagate Ultra Wide SCSI hard disk, and a 16X (average speed) ATAPI CD-ROM drive provides fast CD data transfers. These components yielded an above-average ZD Business Disk WinMark 97 score. Other benchmark-test scores were average.

Expansion here is adequate: There are four ISA slots and one 3.5-inch and two 5.25-inch drive bays available. The unit also has USB ports, excellent Altec Lansing ACS31 speakers with subwoofer, and a 33.6/14.4-Kbps fax modem. The two latter features may be more appealing for a small-office/home-office installation than for corporate settings.

The Archer-2000 provides good hardware and performance. You may find the same benefits, however, for a slightly bet-

ter price elsewhere in this roundup.—AP
Archer-2000. Direct price: \$3,199. Total Peripherals Inc., Northboro, MA; 800-923-7718, 508-393-1777; fax, 508-393-9211; www.totalpc.com. Circle 495 on reader service card.

TradeMark Computer Products

TradeMark TM200MMX

The TradeMark TM200MMX (\$2,800 street) offers average performance and a three-year warranty. But other systems in this roundup may provide more bang for the buck. TradeMark Computer Products is a division of Almo Distributing, a Philadelphia-based company which also sells consumer electronics products.

This system's Baby AT-style motherboard uses Intel's 430HX chip set and is backed up by EDO DRAM. The 5,400-rpm 2.4GB Enhanced IDE hard disk is on the small side for this group yet should get the job done. Adding drives should be easy, as the PC's case provides five available drive bays.

Our evaluation unit came with a 33.6/14.4-Kbps fax modem from Boca Research, which is less valuable in a corporate setting than a LAN adapter would be. It also had a serviceable sound system, with a Creative Labs Sound Blaster 16 card and Koss HD-30 speakers. The CD-ROM drive was a 12X TEAC ATAPI model. The system came in with average performance on our benchmark tests. Its entire package is backed by an attractive three-year warranty that covers parts and labor.—AP

Trademark TM200MMX. Street price: \$2,800. TradeMark Computer Products, Marlboro, MA; 800-232-9920, 508-480-9099; fax, 508-480-8732; www.almo.com. Circle 496 on reader service card.

Transource Computers

Transource-MTX200

The Transource-MTX200 (\$2,108 direct), from Transource Computers, comes at a bargain price, which makes it one of the most economical PCs in our roundup. But this price is offset by poor graphics performance. The company began selling PCs locally in 1984 and thereafter went into national distribution.

The product's ATX-style motherboard

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VeriTest Battery Life Results in Hours***

TravelMate 7000 (166MHz MMX)	7:26
IBM ThinkPad 760ED (133MHz)	2:38
Toshiba Tecra 720 CDT (133MHz)	2:38
Dell Latitude XPI (150MHz)	4:15
HP Omnibook 5500 CS (120MHz)	2:35



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*7-hour battery life based on VeriTest Cross Country test March 1997 running Windows 95. ***Full results available at www.veritest.com/tm7000xc.htm

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features Intel's 430HX chip set, 256K of L2 cache, and integrated sound. The Matrox Mystique graphics adapter couldn't keep up with others in the roundup. All other test scores were average, however.

This system is notable for its three free IRQs. Transource bundles a lot of software with the unit, including Corel's WordPerfect 7 Suite and some 3-D games (which corporate buyers may not find so appealing). The product also includes an excellent pair of Altec Lansing ACS51 speakers.

There were some signs of poor fit and finish in the assembly of our test unit. For example, the 2.9GB Western Digital hard disk was mounted to the case with just a single screw—not a secure arrangement. But if you're looking to save a few dollars, you may still be able to get most of the features you need by going with the Transource-MTX200.—AP

Transource-MTX200. Direct price: \$2,108. Transource Computers, Phoenix; 800-486-3715, 602-997-8101; fax, 602-997-8886; www.transource.com. Circle 497 on reader service card.

Tri-Star Computer Corp.

Tri-CAD IA5 MMX

While the Tri-CAD IA5 MMX (\$2,600 street), from Tri-Star Computer Corp., is competitively priced, the system is saddled with poor performance.

Its mini-tower case holds a Baby AT-style motherboard with Intel's 430HX chip set and EDO DRAM. Two 5.25-inch and two 3.5-inch drive bays are available for expansion, along with two ISA slots (both of which cannot take more than a half-length card because of the CPU fan blocking the way), two PCI slots, and one shared slot.

Using the STB Velocity 3-D graphics card, we found the unit's Graphics WinMark 97 score was the worst of the field (an older driver may be the culprit). This in turn dragged the unit's Winstone 97 score to the bottom of the heap as well. Other results were average.

Our evaluation unit's remaining hardware included a 17-inch iiyama monitor with good picture quality, a Sound Blaster-compatible sound card, and Ben-

win speakers with adequate sound for business use.

Poor performance diminishes the Tri-CAD IA5 MMX's appeal. Given our tests, you may find a better bargain elsewhere.—AP

Tri-CAD IA5 MMX. Street price: \$2,600. Tri-Star Computer Corp., Tempe, AZ; 800-800-7668, 602-731-4926; fax, 602-731-9010; www.tri-cad.com. Circle 498 on reader service card.

Unitek Technology Inc.

Unitek UT-P200MMX Trojan

The Unitek UT-P200MMX Trojan (\$2,725 direct), from Unitek Technology, offers competitive performance and includes some useful software extras.

The unit's motherboard incorporates Intel's 430VX chip set, as well as four SIMM slots and two DIMM slots (these types cannot be used simultaneously). A 7,200-rpm Fast/Wide SCSI-2 4.2GB Quantum hard disk, paired with an Adaptec 2940UW SCSI adapter, places it

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ThinkPad



pentium

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a cut above many competing machines we looked at for this roundup. This disk subsystem earned an above-average score on our Disk WinMark 97 tests; other scores were average.

The system is bundled with a Viewsonic 1769GA-1 monitor with internal speakers—an important space-saving feature in cramped office sites. And Unitek includes Microsoft Office Professional 97.

The Trojan is handicapped for expansion. There are two ISA slots (one occupied by a Sound Blaster 32 audio card), but you can't fit more than a half-length card in either. The first is blocked by a heat sink; the second is so close to the CPU fan that components on the card may hit it. There are three drive bays, however, in addition to a PCI and a shared slot.

The Trojan's good performance and appealing components are somewhat offset by a limited one-year warranty.—AP

Unitek UT-P200MMX Trojan. Direct price: \$2,725. Unitek Technology Inc., Ontario, CA; 800-944-5650, 909-930-5700; fax, 909-930-5710. *Circle 499 on reader service card.*

Vektron

Vektron Home Office 200M

The Vektron Home Office 200M (\$2,395 direct) is bargain priced. Its performance was mostly average, but the unit's Business Graphics WinMark 97 score was one of the worst here.

The product's Baby AT-style motherboard is outfitted modestly with EDO DRAM and Intel's 430HX chip set. Also included here are some strong components, such as a Quantum Fireball 3.6GB Enhanced IDE hard disk, a 17-inch MAG DX700T monitor (based on a Trinitron tube), and a 16X CD-ROM drive. Our evaluation unit came with a 33.6/14.4-Kbps fax modem (a LAN adapter might be more useful in corporate installations).

These components delivered average scores on most of our tests. But the system's Matrox Mystique graphics card with 4MB of SGRAM contributed to a Graphics WinMark 97 score tied for last place.

Vektron backs the system with a one-

year parts-and-labor warranty; on-site service is \$50 extra. Our evaluation unit evidenced a mix-up at the company, as the keyboard had the wrong plug type and unfortunately couldn't be connected to the system.

Some buyers may find the Vektron-Home Office 200M's low price and good components compensate for poor graphics performance.—AP

Vektron Home Office 200M. Direct price: \$2,395. Vektron, Grand Prairie, TX; 800-725-0020, 972-606-0280; fax, 972-606-1278; www.vektron.com. *Circle 500 on reader service card.*

Xi Computer Corp.

Xi MX200 MTower

The Xi MMX200 MTower (\$2,549 direct), from Xi Computer Corp., boasts an attractive price and components. It yielded competitive scores on our benchmark tests.

The unit's midsize tower houses an ATX motherboard with Intel's new 430TX chip set and synchronous

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Other prices range up to \$3,999. 5CD-ROM, 500MB hard disk, and 16X CD-ROM drive. All prices are suggested retail prices and may vary. IBM, the IBM logo, and the ThinkPad logo are registered trademarks of International Business Machines Corporation. Lotus, the Lotus logo, and Lotus SmartSuite are registered trademarks of Lotus Development Corporation. Pentium and the Intel Inside logo are registered trademarks of Intel Corp. © 1997 IBM Corp. All rights reserved.

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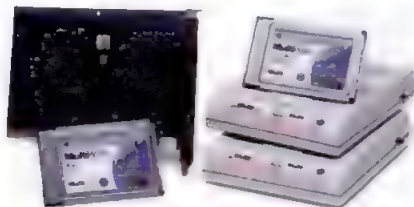
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CIRCLE 179 ON READER SERVICE CARD

DRAM. Also featured are a pair of USB ports, a 5,400-rpm 4.8GB Maxtor hard disk, and a 16X CD-ROM drive. There are even two standard infrared ports. The Maxtor hard disk earned the system an above-average Disk WinMark 97 score. Other benchmark test scores were average.

Expanding this unit is easy. You have plenty of room with five open drive bays, and with one shared, two ISA, and three PCI slots free. The case provides easy access to the six SIMM and two DIMM sockets (they can be used together) and other components for painless upgrades.

The Xi MX200 MTower also includes a pair of Altec Lansing ACS52 speakers for good-quality sound.

The Xi MX200 MTower offers some strong disk performance as well, making the system a reasonable choice.—AP.

Xi MX200 MTower. Direct price: \$2,549. Xi Computer Corp., San Clemente, CA; 800-432-0486, 714-498-0858; fax, 714-492-6571; www.xicomputer.com. Circle 501 on reader service card.

Zenith Data Systems Direct

ZDS Performance 200x

Zenith Data Systems Direct's ZDS Performance 200x (\$2,899 street) offers some attractive components and was an average performer. And with an exceptional monitor and a great sound system, it's well worth the price.

The unit's tower case houses an ATX motherboard with Intel's 430HX chip set. Unlike many systems that have a CPU cooling fan, this product relies on a passive heat sink. Performance was average on our tests.

Expansion options are adequate here: four bus slots and three drive bays. The system has no USB ports and is not DMI-compliant. Our unit came with a 33.6/14.4-Kbps fax modem, but a 10/100-Mbps Fast Ethernet card may be preferable for networked installations. You can get a network card instead of the modem without extra cost.

The included Sampo monitor accepts two input signals via a standard sub-D connector and separate BNC coaxial ca-



bles. This allows separate video composite capability for graphic designers (requiring a video card upgrade). The system also has excellent Cambridge SoundWorks satellite and subwoofer speakers, as well as a 12X Toshiba CD-ROM drive.

The ZDS Performance 200x offers a lot: good performance, a terrific sound system, and flexibility.—AP

ZDS Performance 200x. Street price: \$2,899. Zenith Data Systems Direct, Boxborough, MA; 800-261-7926, 508-635-6700; fax, 508-635-6790; www.zdsdirect.com. Circle 502 on reader service card.

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the

Big Screens

A 20- or 21-inch monitor is a must for graphics professionals and CAD users, and it can improve the productivity of any business user. PC Labs tests 17 of the best. *By Bruce Brown*



PRICES ARE FINALLY FALLING IN THE LAST HOLDOUT PC category: big monitors. Over the past two years, price drops on CPUs, memory, hard disks, and video cards have resulted in greater access to more powerful computing. But for most users, 17-inch monitors have defined the upper limit of affordability in displays. Now 20- and 21-inch monitors are seeing significant reductions, while

providing higher resolutions and refresh rates for rock-solid imagery.

Graphics professionals, desktop publishers, and CAD/CAM users traditionally have used large-screen monitors. As prices drop—to \$1,800 for a high-quality display or less for a merely adequate one—mainstreamers can discover the benefits. A typical business user can have

Apple Vision 850.....	173	IBM P200 Color Monitor.....	178	NSA/Hitachi SuperScan Elite 802.....	181
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Join us online for the interactive version of "The Big Screens," with patterns to test your monitor. WWW.PCMAG.COM

more active windows on-screen to bounce easily between e-mail and a word processor while keeping track of Internet news in a third window. A larger screen also means you can run at a higher resolution (1,280-by-1,024, or even 1,600-by-1,200). You can see more of a document or spreadsheet on-screen at one time.

While the market for 20- and 21-inch PC monitors is small, there's growth ahead. In 1996, such monitors accounted for just 3 percent of the U.S. market. In comparison, 15-inchers had 40 percent. But big-monitor sales should grow 25 percent this year, according to San Jose-based market research firm Stanford Resources, and more dramatic growth may be in the offing with the arrival of big-screen monitors selling for as little as \$1,000.

REVIEW CRITERIA

Most major vendors now offer a range of large screens. There are *value line* monitors for the budget-oriented with higher dot pitches, lower resolutions and refresh rates, and fewer of the latest image and color controls; as well as *mainstream business* displays for executive offices, general business use, and light desktop publishing. The heart of the 20- and 21-inch market remains the high-end for graphics and publishing professionals, CAD, document imaging, and Web site authoring. For this roundup, we tested the professional series monitors from the largest vendors, determined by Stanford Resources' figures on 20- and 21-inch shipments in 1996.

JUDGING THE IMAGE

The primary measures of image quality remain resolution, mask pitch, and refresh rate. The tested monitors all support 1,600-by-1,200 *resolution* (the number of pixels making up the horizontal and vertical lines). The MAG InnoVision DJ920, the Panasonic PanaSync/Pro P21, and the Philips Brilliance 201CS can run at 1,800-by-1,440 resolution in noninterlaced mode. Graphics and CAD users may opt for these higher resolutions to get more of a design on-screen, but for business applications, a more comfortable resolution is 1,280-by-1,024, or the less common 1,152-by-864.

Mask pitch—the distance between phosphor dots of the same color—is another important measure. Generally, the tighter the mask pitch, the sharper the

Editors' Choice

ViewSonic PT813



We were very impressed with most of the 17 high-end

20- and 21-inch monitors that ZD Labs tested. The best of these \$1,250 to \$2,200 monitors is the ViewSonic PT813, which combines image quality and affordability (\$1,800 street). The PT813 was a standout on our objective tests and garnered the top MonMark score. Its 0.28-mm aperture grille produced images that were flawless: bright, crisp, and uniform, with well-saturated colors. It's a terrific value.

Three other monitors deserve honorable mention. Users who need a monitor with ultrahigh bandwidth should consider the Philips Brilliance 201CS or the Sony Multiscan 20seII Trinitron. The Brilliance (\$2,000 street), built around a 0.22-mm 21-inch Invar shadow mask tube, can deliver a top resolution of 1,800-by-1,440 at an acceptable 71-Hz refresh rate (or 1,600-by-1,200 at 85 Hz). Its picture was superb. The 20-inch Multiscan 20seII (\$1,999 list) uses Sony's new Trinitron aperture grille CRT with a fine 0.25-mm mask pitch. Colors popped and images were photorealistic. Finally, the Cornerstone Color 50/101sf (\$1,570 street) is among the best monitors we've seen for text-intensive applications. Images on the 21-inch Invar shadow mask CRT were extremely clear and precise, making it easy to read even the smallest text.

image. Nine monitors in this roundup use *aperture grille* CRTs (Mitsubishi's DiamondTron or Sony's Trinitron), which have an array of stretched wires to create images using phosphor lines. The rest use traditional *Invar shadow mask* tubes, which employ a thin sheet of perforated metal in front of the CRT to create discrete phosphor dots. Shadow mask tubes

in this review have a dot pitch of between 0.22 mm and 0.28 mm. Aperture grille tubes can give just as sharp a picture with a slightly larger pitch—between 0.25 mm and 0.31 mm. The only way to tell the difference between the two types is the hair-thin (but still visible) horizontal damping wires used to hold aperture grilles in place.

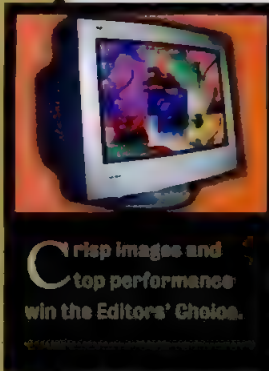
Flicker-free refresh rates are important for comfortable viewing, especially graphics professionals. The *refresh rate* is the number of times the screen image is redrawn, and a low rate means noticeable screen flicker that can lead to eyestrain. The vertical refresh rate recommended for

ergonomic viewing is 85 Hz, though a rate of 75 Hz is acceptable for the short term. All of the tested monitors are able to run at 75 Hz or higher in 1,280-by-1,024 resolution mode. If you routinely work in 1,600-by-1,200 mode, your best choice is one of four high-bandwidth models that can deliver

it at 85-Hz refresh: the models from MAG, Panasonic, and Philips, or the ViewSonic PT813 (our Editors' Choice).

Finer control over image and color attributes is another sign of a top monitor. All the test units have advanced on-screen displays to help you tweak monitor settings. The EIZO Nanao, Mitsubishi, and Philips models also have serial ports and software utilities so you can control the display configuration and settings using your mouse and keyboard.

Extraordinary demands on image and color control are common in the graphics industry, where separate controls for horizontal and vertical convergence, color temperature tuning, and configuration lockouts boost productivity. Many of the monitors have magnetic field correction to compensate for the effect of the earth's magnetic fields as monitors are used in different parts of the Northern hemisphere or shifted to face a different direction; 20- and 21-inch monitors are more prone to magnetic field effects than smaller monitors.



Crisp images and top performance win the Editors' Choice.

Our Contributors: BRUCE BROWN is a contributing editor of *PC Magazine*. JOHN BRYAN is a freelance technology writer. JAMIE M. BSALES was the editor in charge of this story, and MICHELLE CAMPANALE was the project leader.

HOW WE TESTED

Performance evaluation included objective and subjective testing. Objective factors such as *MTF (modulation transfer function)*, *luminance*, *convergence*, *pin-cushioning*, *color tracking*, and *uniformity* were tested at ZD Labs and resulted in individual scores, plus the *MonMark* score: a weighted score derived from individual test results.

For eyes-on evaluation, we used photographic images displayed in Adobe Photoshop to evaluate color vividness and saturation. We also used the new DisplayMate for Windows Professional Multimedia Edition 2.0 from Sonera Technologies (800-932-6323, 908-747-6886; www.displaymate.com).

This series of images is designed to reveal the strengths and weaknesses of a range of attributes, including geometric patterns, color scales, uniformity, resolution, regulation, convergence, and focus tests.

OTHER FACTORS

With plenty of top-quality monitors to choose from, it's hard to go wrong. You may want to look more closely at differentiating features rather than just test results. For example, 11 of the monitors accept two simultaneous inputs, so you can connect a single monitor to two machines and toggle between them. Case size is another factor. Monitors generally are as deep as their diagonal screen size, so a 21-inch monitor will be about 21 inches deep—perhaps too big for your cubicle desktop. Three of the makers (Gateway

2000, iiyama, and Mitsubishi) have managed to shave that down some, delivering a footprint just over 19 inches deep.

One other development on the horizon may affect your buying decision: A new breed of affordable, high-quality 19-inch monitors will start appearing this summer. These give you 25 percent more screen real estate than a 17-inch model

Plug and Play support made setup a breeze. Full-screen geometry and color controls, including color-mode locking as well as adjustments for ambient lighting and screen aging, mean that you can set the monitor to your preferences once with the assurance that performance will stay constant. A top-tier MonMark score (tied for third in this roundup) reflects the

The Cornerstone
Color 50/101s/
produced clear, legible
text. The AppleVision 850
delivered excellent
images. The Compaq
QVision 210's image
quality was below par.



but, at \$950 to \$1,200, cost significantly less than most comparable 21-inch models. If you do need the larger monitor for page layout, Web site design, CAD/CAM, graphics editing, document imaging, or simple productivity applications, these outstanding choices can make your work much more pleasant.

AppleVision 850

Apple Computer's AppleVision 850 (\$1,850 street) is a good choice for its intended publishing and Web authoring markets. Featuring Sony's new 20-inch Trinitron aperture-grille tube with the ultrafine 0.25-mm mask pitch, the AppleVision was one of the overall high-scoring monitors on the objective tests and equally impressive in subjective testing.

The AppleVision's digital controls and

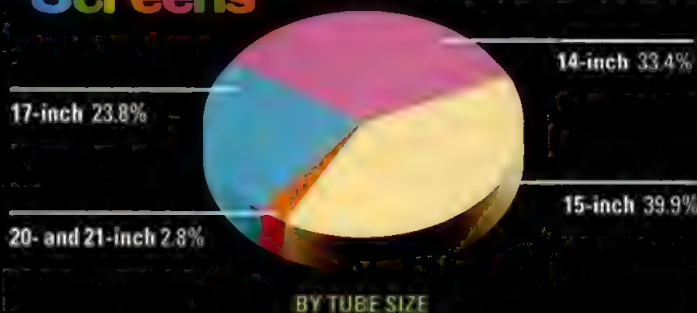
AppleVision's terrific performance on the individual Luminance, Uniformity, and Misconvergence tests. In subjective testing, photograph colors and flesh tones were impressive, and the DisplayMate test patterns for color handling, focus, and geometry turned up very little variation or weakness. Color registration was particularly tight and can be kept so with both horizontal and vertical convergence controls. The AppleVision 850 is a fine choice for both PC and Macintosh users.

Compaq QVision 210

The Compaq QVision 210 (\$1,900 street), introduced in the fall of 1995, is Compaq Computer Corp.'s first monitor directed at CAD/CAM market and technical and professional users. It has a 21-inch Invar shadow mask tube with a 0.26-mm dot

Big Screens

A Small but Significant Slice of the Pie



Figures are for 1996 and, unless otherwise noted, were provided by Stanford Resources.
*The figure is based on independent research provided to PC Magazine.

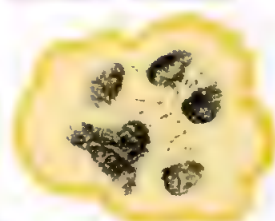
U.S. MONITOR MARKET BREAKOUT

BY VENDOR, FOR 20- AND 21-INCH UNITS

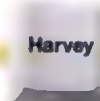
Vendor	Number	Vendor	Number
Apple	35,175	Mitsubishi	40,953
Compaq	19,880	NEC	79,175
Cornerstone	22,917*	Nokia	11,319
Dell	15,214	NSA/Hitachi	57,152
EIZO Nanao	15,453	Panasonic	13,503
Gateway 2000	23,051	Philips/Magnavox	13,755
IBM	14,180	Radius	27,168
Iiyama	24,860*	Sony	45,447
MAG InnoVision/Princeton	11,962	ViewSonic	100,722
		Other	83,628

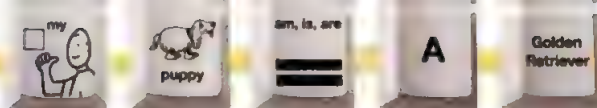


Christian Murphy was non-verbal. He lived with a wall between himself and the world.



1 THIS IS CHRISTIAN.
He can see, hear, feel, touch,
but he cannot speak. He was born
with autistic tendencies that cut
him off from the world around him.





2 A TEACHER DISCOVERED that Christian would respond to images from his life. She put visual cues to the story of his new puppy on a special keyboard.



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E500	1280 x 1024 @ 65Hz	119MHz	CROMACLEAR	0.25mm mask
E700	1600 x 1200 @ 65Hz	177MHz	CROMACLEAR	0.25mm mask
E1100	1600 x 1200 @ 65Hz	177MHz	Dot Trio	0.28mm dot



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pitch, and while it's still a reasonable performer for many applications, the QVision's objective and subjective test results showed it to be somewhat below average in this very competitive field.

Setup and configuration were easy. A four-button control panel makes it easy to set and maintain image quality, though

was crisp and legible. If you need an ultra-crisp display for text-intensive applications, there is none better.

Dell UltraScan 20HS

The Dell UltraScan 20HS (\$1,600 direct) is a competent performer at an attractive price. Dell Computer Corp. positions this

proved to be an acceptable display, but its low score on objective tests and good but not great performance in subjective tests suggests that the most demanding users look elsewhere, or even higher in EIZO Nanao Technologies' line.

The monitor boasts a digital convergence feature and white uniformity com-

compensation to keep colors precise. Simple display-control buttons ease adjustments, and a full range of controls includes moiré pattern cancellation and magnetic field compensation. A snap-on USB hub option (no pricing announced) should be available by the end of the year, making this a monitor to grow with.

In objective testing, the FlexScan's overall MonMark score was marred by much-greater-than-average misconvergence, noticeable in subjective testing as well; it also scored poorly on our Luminance measure. In subjective observation, the FlexScan was generally pleasing but often not quite as sharp, rich, or consistent as many of the other monitors.

Gateway Vivitron 1100

Other monitor vendors submitted their professional-level units for this review, but Gateway 2000 only has a mainstream offering: the Gateway Vivitron 1100 (\$1,250 direct). Made for Gateway by Mitsubishi around a 21-inch DiamondTron aperture grille tube (with a 0.28-mm mask pitch), the Vivitron is a terrific value for business and home users who need more screen real estate for productivity applications. The Vivitron is not a high-bandwidth display, delivering 1,280-by-1,024 resolution at an

there are few advanced features (moiré cancellation, convergence, and magnetic field correction) that are now standard on other high-end monitors. Photographic image flesh tones were very good in subjective tests, but the colors of our sample still-life photos were off just a bit. With the DisplayMate resolution and focus test patterns, the overall quality was good but at times was better in the center of the screen than on the sides and corners. The QVision 210 shows its age in a field of newer models.

Cornerstone Color 50/101sf

Cornerstone Imaging has built its reputation by providing high-end, purpose-tuned display *subsystems*: monitors and graphics controllers designed for document imaging. The monitors can be purchased and used separately from the controllers, and the Cornerstone Color 50/101sf (\$1,570 street) we tested showed that even for day-to-day office-productivity applications, the company's focus on ultrasharp on-screen text has paid off handsomely.

Using a 21-inch Invar shadow mask tube with a 0.27-mm mask pitch, the Color 50/101sf was at or near the front of the pack on many of our objective test measures, tying for third overall for its MonMark score. A refresh rate of 94 Hz at 1,280-by-1,024 resolution (compared with 85 Hz for most other monitors here) means a rock-steady image.

In subjective evaluation, on-screen images were excellent. Photographic images were accurate and well saturated, and text

monitor for the power user in today's graphical environments, and its optimal resolution of 1,280-by-1,024 at an 85-Hz refresh rate makes it a good choice for Microsoft Windows 95 or Windows NT.

The 20-inch Trinitron aperture grille tube (with a 0.26-mm mask pitch) produced a sharp, bright picture, with vivid, accurate colors. Scores on our objective tests were generally average or a touch above, and the unit placed in the middle of the pack in terms of its MonMark score. Note that while anyone can call Dell and buy the monitor, it is sold primarily as an option with preconfigured Dell PC systems; stand-alone monitors do not come with the .INF files that optimize the monitor's performance under Windows 95 or Windows NT.

EIZO Nanao FlexScan FX-E7

The EIZO Nanao FlexScan FX-E7 (\$2,000 street) is a midrange unit in this high-end display maker's arsenal. The 21-

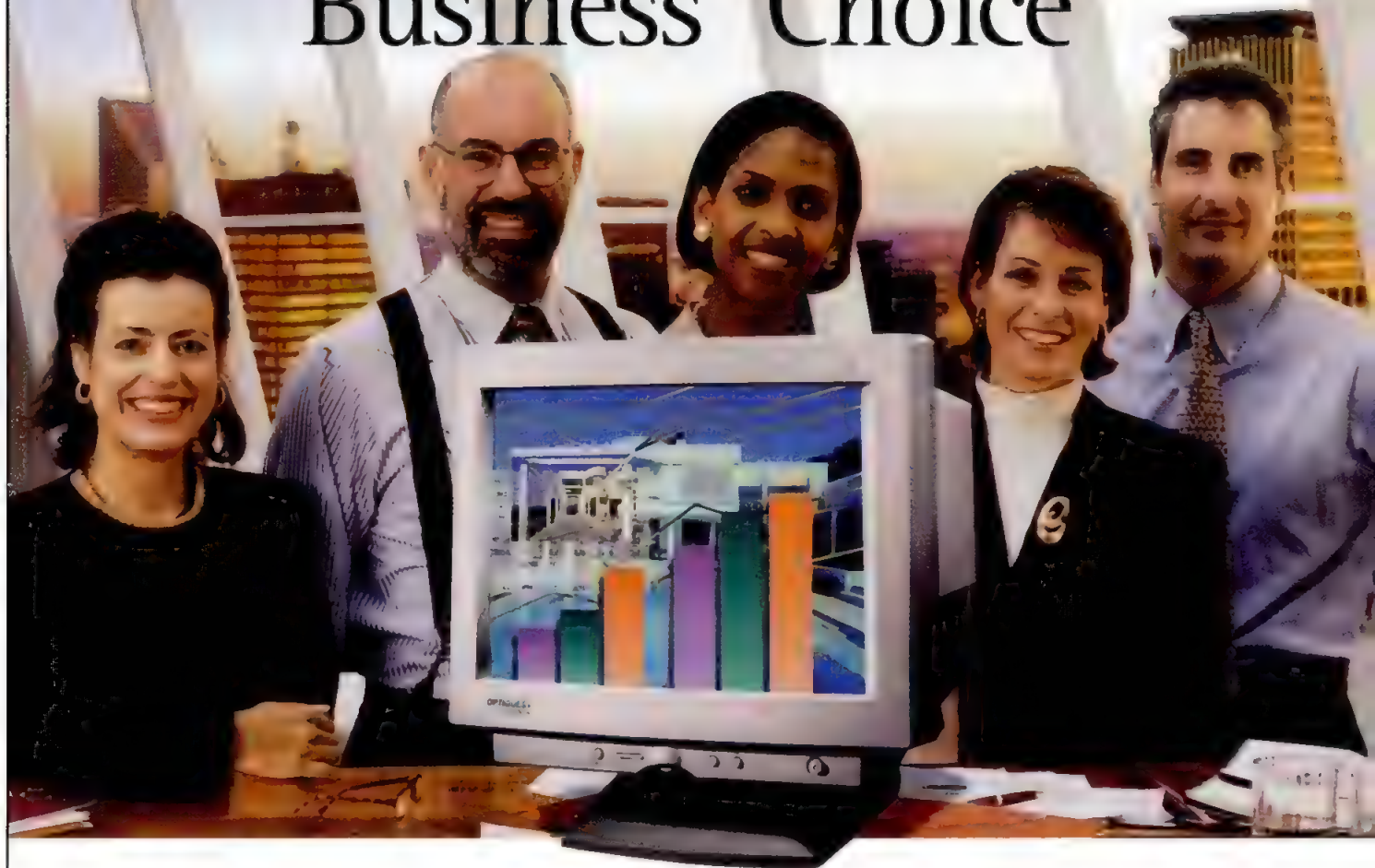
The **Iiyama VisionMaster** is a solid choice. The MAG innovation has easy-to-use controls. IBM's P200 delivered a sharp picture.



inch model we tested (which has a 0.28-mm Invar shadow mask tube) is intended for use in business, desktop publishing, and CAD/CAM markets. The FlexScan

acceptable (though not ideal) 75-Hz refresh, whereas most others here can deliver 85 Hz. More demanding CAD pros and image editors will want to opt for one of

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OPTIQUEST MONITORS							
	0100	V775	V773	071	V655	053	V641
Size/Viewable	20"/18.4"	17"/16.0"	17"/15.8"	17"/16.0"	15"/13.8"	15"/13.8"	14"/13.2"
Dot Pitch	0.28mm	0.26mm	0.26mm	0.28mm	0.28mm	0.28mm	0.28mm
Max. Resolution	1600 x 1280	1600 x 1280	1280 x 1024	1280 x 1024	1280 x 1024	1280 x 1024	1024 x 768
Horiz. Scan Freq.	30-86kHz	30-85kHz	30-69kHz	30-70kHz	30-65kHz	30-70kHz	31.5/37.5/48 kHz
MSRP	\$1,149	\$699	\$599	\$559	\$339	\$319	\$229

Prices effective April 1, 1997

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Optiquest V775
 October 1996

BENCHMARK TESTS

21-Inch Monitors



Most of the 17 monitors performed well on our test suites.

The ViewSonic PT813 won the top MonMark score, with the Mitsubishi Diamond Pro 91TXM a close second, and the AppleVision 850 and the Cornerstone Color 50/101sf tied for third.

How We Tested

The **MonMark** score is derived from the objective test measurements of each monitor, based on screen attributes most important to a business user. To calculate the MonMark, we weight the individual results of the eight tests presented here and derive the overall MonMark score.

To measure **Average MTF** (modulation transfer function), an indication of a monitor's sharpness, we display a pattern of alternating *on* and *off* lines, 1 pixel wide, in both the horizontal and vertical axes. We report the average of the horizontal and vertical test results, measured both at the center and at one corner of the screen. A score above 60 percent is excellent; below 35 percent is unacceptable.

Misconvergence occurs when the electron beams that excite the monitor's red, green, and blue phosphors are misaligned, creating color halos around screen objects. For the **Misconvergence** test, we measure the beam displacement among red, green, and blue pixels near each corner and at the center of the display, in both the horizontal and vertical axes. We report the root mean square (RMS) of these results. A score below 0.10 mm is excellent; a score above 0.20 mm is unacceptable.

the higher-end units in this review.

Set up and configuration are very easy, and the Vivitron offers moiré cancellation controls, though it lacks other high-end features such as magnetic field correction and configuration lockout. Performance on our objective measures was good—especially considering the unit's low price—and the Vivitron placed just a touch below average in terms of its MonMark score. In subjective testing, image geometry as well as color richness and uniformity were very good, with only minor variations that were often easy to fix with control adjustments. A good buy with little compromise, the Gateway 2000 is an attractive, affordable business display.

IBM P200 Color Monitor

The IBM P200 Color Monitor (\$1,630 street) is a moderately priced display in-

tended for graphics and CAD professionals. Based on a 20-inch Sony Trinitron aperture grille tube (0.31-mm mask pitch), the unit's top-five finish among MonMark scores shows that it's a good choice for most graphics applications.

The P200 includes moiré cancellation and convergence adjustment in its array of screen-geometry, uniformity, and color controls. But the monitor's best feature is its exclusive anti-glare coating, a seven-layer process developed by IBM that increases contrast and sharpness. This product won the best Average MTF score in our roundup. On subjective tests, the monitor had good color in photographic images, tight geometry control and resolution, and only minor registration errors that were easily corrected with the convergence control. The P200's performance and price make it a fine choice.

Pincushioning describes how a straight line curves or bows on-screen. The **Horizontal Pincushioning** and **Vertical Pincushioning** tests measure the curvature of lines placed at the center and edges of the display. We use the monitor's controls to correct errors as much as possible; we report the RMS of the results. A score of 0.45 mm or less is considered excellent; more than 0.65 mm is likely to be noticeable to the eye.

Luminance represents the perceived brightness of a monitor. For the **Luminance** test, we adjust a test pattern for optimal contrast in normal room-lighting conditions; then we measure each

	MonMark Score	Average MTF Percent
Bold type denotes first place.		
AppleVision 850	169	43
Compaq QVision 210	146	56
Cornerstone Color 50/101sf	169	70
Dell UltraScan 20HS	161	46
EIZO Nanao FlexScan FX-E7	144	59
Gateway Vivitron 1100	152	53
IBM P200 Color Monitor	168	84
iiyama VisionMaster Pro 21	165	61
MAG Innovision DJ920	147	50
Mitsubishi Diamond Pro 91TXM	174	73
NEC MultiSync P1150	160	49
Nokia Multigraph 445 Xi	151	56
NSA/Hitachi SuperScan Elite 802	155	60
Panasonic PanaSync/Pro P21	145	61
Philips Brilliance 201CS	168	56
Sony Multiscan 20sell Trinitron	165	43
ViewSonic PT813	177	72

BETTER ►

BETTER ►

iiyama VisionMaster Pro 21

iiyama North America is building a following as a maker of affordable high-end displays for graphics professionals. The performance of the iiyama VisionMaster Pro 21 (\$1,620 street), built around a 21-inch DiamondTron aperture grille CRT (0.30-mm mask pitch), makes it a solid choice.

The unit placed above average for its MonMark score. In subjective testing, decent luminance combined with good color tracking and great uniformity resulted in very sharp images. The company will be one of the first to market with a USB solution: A swivel base (\$149 list) with a built-in USB hub should be available by the time you read this, and users will be able to upgrade without replacing the entire monitor. If you're in the market for a cost-conscious graphics display with a future, consider the VisionMaster.

unit's brightness at the center of an all-white screen. A higher score indicates that a unit can produce a brighter image without bringing the black areas to gray, which would lower sharpness and contrast. A score above 35fL (foot-lamberts) is excellent; below 18fL is unacceptable.

Uniformity describes how little luminance and color vary across the display, and the **Color Uniformity** and **Luminance Uniformity** tests measure this variance. Less than 7 percent variability is excellent.

We obtained these results using a Microvision SuperSpot 200

and its built-in video generator card (a Quantum Data Model 801 GF-ISA), set to a resolution of 1,024 by 768 pixels at a vertical refresh rate of 75 Hz. For Luminance, Color Uniformity, and Luminance Uniformity scores we use a Minolta Color Analyzer CA-100.

In addition to the objective measurements, we perform subjective analyses of screen attributes using a range of test patterns from Sonera Technology's DisplayMate for Windows Professional Multimedia Edition 2.0, as well as PhotoCD images viewed in Adobe Photoshop.

Misconvergence Millimeters	Horizontal Pincushioning Millimeters	Vertical Pincushioning Millimeters	Luminance Foot-lamberts	Color Tracking Percent	Luminance Uniformity Percent	Color Uniformity Score
0.08	0.52	0.52	39	96	4	8
0.12	0.60	0.94	28	95	5	10
0.11	0.25	0.72	27	90	4	6
0.10	0.27	0.40	27	95	4	12
0.22	0.47	0.86	25	92	4	26
0.17	0.56	0.34	32	98	6	15
0.41	0.96	0.42	28	97	4	13
0.10	0.59	0.50	27	94	2	17
0.10	0.95	0.47	25	97	4	12
0.08	0.69	0.25	29	97	4	15
0.11	0.27	0.66	27	85	4	6
0.09	0.57	1.51	29	98	5	16
0.11	0.82	0.78	34	91	4	20
0.09	0.55	0.64	26	92	10	21
0.13	0.42	0.75	31	96	3	8
0.10	0.34	0.24	27	96	3	12
0.09	0.39	0.79	27	87	3	8
< BETTER	< BETTER	< BETTER	BETTER >	BETTER >	< BETTER	< BETTER

MAG InnoVision DJ920

If you need quick, intuitive—and almost fun—access to your monitor's image controls, the MAG InnoVision DJ920 (\$1,600 street) is a step ahead of most others: Its unique JAG (rhymes with MAG) dial-a-matic control pad makes changing settings a snap without having to worry about rebooting. The high-bandwidth InnoVision presented a pleasing, flicker-free picture, and you can push the resolution to 1,800-by-1,440 and still get a usable refresh rate of 73 Hz. If you work mostly in 1,280-by-1,024 mode, you'll get a rock-steady 101-Hz refresh. A couple of disappointing individual scores in objective testing, however, brought down the unit's MonMark score.

The InnoVision has a 21-inch Invar shadow mask CRT with a 0.28-mm dot pitch. The JAG control is especially easy to

use, and the unit features all the advanced image-attribute settings you could want.

In our subjective evaluation of image quality, the InnoVision rated highly, with a sharp, crisp, well-saturated look. On objective performance measures, the InnoVision offered up a mixed bag. Scores on our Horizontal Pincushioning and Luminance tests were poor, with other results generally midpack. Still, the ease of use, range of resolution options, and eyes-on image quality make this unit worth considering.

Mitsubishi Diamond Pro 91TXM

Mitsubishi takes another tack on total control with the Mitsubishi Diamond Pro 91TXM (\$1,600 street). Targeted at the corporate desktop and image editors, the Diamond Pro features a system-level

Windows utility that accesses display logic through a serial communications port (though you'll need to surrender one of your PC's serial ports to use it). This utility lets you adjust the display with a much greater degree of control than with front-panel buttons.

The 21-inch unit is based around the company's own DiamondTron aperture grille tube (0.28-mm mask pitch). The Diamond Pro was a standout on nearly every test and placed second overall (behind the ViewSonic model) for its MonMark score. Displayed images were extremely vivid and photorealistic. Our particular display had a very slight but uncorrectable horizontal pincushioning effect in one corner, but not enough to mar our opinion. Given its image quality and reasonable price, the Diamond Pro belongs on your short list.



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NEC MultiSync P1150

NEC Technologies' MultiSync P1150 (\$1,850 street) is packed with impressive technologies to set and maintain accurate and consistent display geometry and color. Intended primarily for graphics, CAD, and Web design applications, the P1150 uses a 21-inch DiamondTron aperture grille CRT (0.28-mm dot pitch). Both objective and subjective tests proved the MultiSync to be a fine performer.

form the numbers recorded on our objective tests, which were generally average or a little below. A somewhat high Vertical Pincushioning error was not detectable on either the DisplayMate test or Photoshop images.

If the 445 Xi has a noticeable Achilles' heel, it's the on-screen display controls, which weren't as extensive or as intuitive as some. But images were sharp and clear, with crisp edges on the smallest detail and great color depth and accuracy.

Panasonic PanaSync/Pro P21

We were similarly disappointed with the Panasonic PanaSync/Pro P21 (\$1,900 street), which also proved to be less than the sum of its parts. A high-bandwidth model built around a 21-inch Invar shadow mask tube with a fine 0.25-mm dot pitch, the PanaSync's image should have been sharp and clear. It wasn't. In order to get the best focus in text-intensive displays, we had to reduce the contrast to significantly below optimal. Our Photoshop images looked almost as though there was a sort of film over them, and colors lacked intensity.

Our objective tests verified our subjective impressions: The PanaSync had the second-lowest luminance rating in our test group, and color uniformity was also poor. Our DisplayMate tests showed a strange, left-side area of heavy distortion and reduced intensity. This monitor also

suffered from a right-side pincushioning distortion we couldn't correct. Where the unit does stand out is bandwidth: It is one of only three units we tested that can support 1,800-by-1,440 resolution, which it does at 71-Hz refresh; 1,280-by-1,024 can be had at a steady 106 Hz. Still, the PanaSync asks too many compromises.

Philips Brilliance 201CS

The Philips Brilliance 201CS (\$2,000 street) is a great choice for high-end professional and graphics applications. Internal speakers and microphone are standard for the display, which uses a 21-inch Invar shadow mask tube with a tight 0.22-mm mask pitch. Moreover, this high-bandwidth unit can deliver 1,800-by-1,440 resolution at an acceptable 71-Hz refresh, and the more optimal

In addition to the usual screen controls, the MultiSync has magnetic field correction called *global synchronization*, convergence adjustment and moiré cancellation, and configuration lockout so that casual users can't change the settings. Occasional on-screen fitness tips can prompt users to take a break.

The unit's average MonMark score reflected its overall average performance on all tests. In subjective testing, small resolution and color discrepancies were easily corrected with user controls except for some minor moiré patterning that the cancellation control couldn't correct.

Nokia Multigraph 445 Xi

Of all the monitors tested, the Nokia Multigraph 445 Xi (\$1,899 list) has style in abundance. And its beauty isn't just skin-deep: The 445 Xi delivers a good-quality image for corporate desktops and demanding graphics applications.

Built around a 21-inch Invar shadow mask CRT with an impressively fine 0.22-mm mask pitch, the unit can be run at its optimal 1,280-by-1,024 resolution with a flicker-free 100-Hz refresh (1,600-by-1,200 is supported at a more-than-acceptable 80 Hz). The result is an image that seems to outper-

The 445 Xi also maintained color and luminance uniformity right out to the edge of its display area.

NSA/Hitachi SuperScan Elite 802

On paper, the NSA/Hitachi SuperScan Elite 802 (\$1,800 street) has all the ingredients of a top-tier graphics and CAD monitor: a 21-inch Invar shadow mask CRT with one of the largest viewable screen areas of the group (20 inches), a 200-MHz video clock, 1,600-by-1,200 maximum resolution at an 80-Hz refresh (1,280-by-1,024 at a luxurious 114 Hz), and extensive display control options including independent left/right pincushioning and trapezoid adjustment. Notable by its absence, though, is the

The NSA/Hitachi SuperScan Elite 802 delivered average-quality images. The Philips Brilliance 201CS was a standout. The Panasonic PanaSync/Pro 21 disappointed us.

performance these specifications would lead one to expect. On our objective tests, the SuperScan Elite was just an average performer.

1,280-by-1,024 at a rock-solid 100 Hz. With high objective testing scores, borne out and exceeded in subjective observation, the Brilliance is an unassailable choice.



Nokia's 445 Xi has a sharp picture. NEC's MultiSync is excellent for CAD. Mitsubishi's Diamond Pro offers photo-realistic images.



SUMMARY OF FEATURES

21-Inch Monitors

■ YES ■ NO □ OPTIONAL

In alphabetical order by company

	AppleVision 850	Compaq QVision 210	Coronetstone Color 50/101sf	Dell UltraScan 20HS	Eizo Nanao FlexScan FX-E7	Gateway Vivitron 1100	IBM P200 Color Monitor
Price	\$1,850 (street)	\$1,900 (street)	\$1,570 (street)	\$1,600 (direct)	\$2,000 (street)	\$1,250 (direct)	\$1,630 (street)
Tube type	Trinitron	Shadow mask	Shadow mask	Trinitron	Shadow mask	Trinitron	Trinitron
Mask pitch	0.25 mm	0.26 mm	0.27 mm	0.26 mm	0.26 mm	0.26 mm	0.31 mm
Tube size/Actual viewable area (diagonal, in inches)	20.0, 19.0	21.0, 19.5	21.0, 19.9	20.0, 19.0	21.0, 20.0	21.0, 19.7	20.0, 19.1
Dimensions (HWD, in inches)	18.8 x 18.7 x 19.7	19.8 x 20.0 x 22.0	18.7 x 19.2 x 20.7	19.4 x 18.6 x 19.7	19.2 x 19.5 x 20.5	19.7 x 19.3 x 19.2	19.4 x 18.6 x 19.7
MPR-II-compliant/TCO-compliant	■ ■	■ ■	■ □	■ ■	■ ■	■ ■	■ ■
Plug and Play (DDC-1 and -2B)/USB-compliant	■ ■	■ ■	■ ■	■ ■	■ □	■ ■	■ ■
Maximum noninterlaced vertical refresh rate at:							
1,800 x 1,440; 1,600 x 1,200	N/A, 75 Hz	N/A, 76 Hz	N/A, 81 Hz	N/A, 75 Hz	N/A, 75 Hz	N/A, 75 Hz	N/A, 75 Hz
1,280 x 1,024; 1,024 x 768	75 Hz, 75 Hz	88 Hz, 116 Hz	94 Hz, 123 Hz	85 Hz, 118 Hz	88 Hz, 117 Hz	75 Hz, 85 Hz	85 Hz, 120 Hz
800 x 600	75 Hz	146 Hz	155 Hz	152 Hz	142 Hz	85 Hz	120 Hz
Macintosh-compatible/Accepts two simultaneous inputs	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
On-screen controls:							
Pincushioning/Pincushioning balance/Trapezoid	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Parallelogram/Tilt/Convergence	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Moiré cancellation/Magnetic-field correction	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Configuration lockout to prevent changes to settings	■	■	■	■	■	■	■
Software utilities	AppleVision	None	None	None	Colorific, ScreenManager Pro	System CD	None
Warranty (CRT, parts, and labor)	1 year	3 years	3 years	1 year	3 years	3 years	3 years
Free express-exchange program provided by vendor	None	None	None	Next day	None	Next day	Second day
Toll-free technical support hours	9:00-9:00 M-F	24 hours, 7 days	9:00-8:30 M-F	24 hours, 7 days	11:00-8:00 M-F	24 hours, 7 days	24 hours, 7 days
Web address	www.powermacintosh.apple.com/displays	www.compaq.com	www.corimage.com	www.dell.com	www.eizo.com	www.gw2k.com	www.pc.ibm.com/monitor

N/A—Not applicable. The product does not have this feature.

The CS in the product name stands for CyberScreen technology, a digital feature that controls color convergence and uniformity for each of 25 sectors. The Brilliance also has a full array of easy-to-use geometry and color controls, including moiré cancellation. The screen automatically sets itself to the correct size and aspect for the given video mode. It was a pleasure to use.

The Brilliance placed fifth overall for its MonMark score. In subjective testing, the monitor's tight geometry, consistent screen focus and registration, and deep, rich colors were pacesetters. The Philips Brilliance

201CS is one of the higher-priced models in this roundup, but its top-quality display characteristics and internal digital controls (which ensure image consistency over time) make the monitor a front-runner for those who insist on the best.

Sony Multiscan 20seII Trinitron

Sony's Multiscan 20seII Trinitron (\$1,999 list) is a winner. The 20-inch Trinitron aperture grille CRT is, fittingly, the company's most advanced to date, with a fine 0.25-mm mask pitch for a clear, sharp picture.

Marry that to a top resolution of 1,600-by-1,200 at 75-Hz refresh and you have an excellent monitor for the most demanding graphics applications you can dish out.

There were no

idiosyncrasies or problems in setup, and a row of ten control buttons on the bottom edge of the case makes adjustment easy. The Multiscan seII scored well in our objective testing, placing near the top with its MonMark score. In subjective testing, the monitor displayed outstandingly vivid and saturated colors, with excellent flesh tones, fine image geometry, and perfect focus. The Sony Multiscan 20 seII Trinitron is worth every penny.

ViewSonic PT813



ViewSonic Corp.—not NEC or Sony—is the largest purveyor of 20- and 21-inch monitors in the U.S., and the ViewSonic PT813 (\$1,800 street) proves that the company has earned the top slot. The PT813 placed first in terms of its MonMark score, and its excellent image quality, features, and attractive price make it this roundup's Editors' Choice. It's an ideal display for image editors, Web designers, and

The ViewSonic PT813 won Editors' Choice for its top MonMark score. The Sony Multiscan 20seII Trinitron produced vivid images.



Iiyama VisionMaster Pro 21	MAG InnoVision DJ920	Mitsubishi Diamond Pro 91TXM	NEC MultiSync P1150	Nokia Multigraph 445 Xi	NSA/Hitachi SuperScan Elite 802	Panasonic PanaSync/Pro P21	Philips Brilliance 201CS	Sony Multiscan Zselli Trinitron	ViewSonic P1813
\$1,620 (street)	\$1,600 (street)	\$1,600 (street)	\$1,850 (street)	\$1,899 (list)	\$1,800 (street)	\$1,900 (street)	\$2,000 (street)	\$1,999 (list)	\$1,800 (street)
DiamondTron	Shadow mask	DiamondTron	DiamondTron	Shadow mask	Shadow mask	Shadow mask	Shadow mask	Trinitron	Trinitron
0.30 mm	0.28 mm	0.28 mm	0.28 mm	0.22 mm	0.22 mm	0.25 mm	0.22 mm	0.25 mm	0.28 mm
21.0, 19.5	21.0, 19.9	21.0, 19.7	21.0, 19.8	21.0, 19.7	21.0, 20.0	21.0, 20.0	21.0, 20.1	20.0, 19.0	21.0, 20.0
19.3 x 19.4 x 19.3	18.9 x 19.8 x 19.9	19.3 x 19.7 x 19.2	20.4 x 20.8 x 22.1	20.5 x 20.2 x 19.7	18.7 x 19.2 x 21.0	19.2 x 19.9 x 20.4	20.7 x 21.1 x 21.7	19.5 x 18.6 x 19.8	19.3 x 19.5 x 20.5
N/A, 75 Hz	73 Hz, 85 Hz	N/A, 75 Hz	N/A, 75 Hz	N/A, 80 Hz	N/A, 80 Hz	71 Hz, 85 Hz	71 Hz, 85 Hz	N/A, 75 Hz	N/A, 85 Hz
88 Hz, 115 Hz	101 Hz, 133 Hz	88 Hz, 118 Hz	88 Hz, 117 Hz	100 Hz, 120 Hz	114 Hz, 123 Hz	106 Hz, 139 Hz	100 Hz, 133 Hz	75 Hz, 75 Hz	100 Hz, 130 Hz
145 Hz	160 Hz	151 Hz	149 Hz	150 Hz	155 Hz	160 Hz	160 Hz	75 Hz	160 Hz
Colorific	None	Diamond Control, DiamondMatch Color Calibration	None	Colorific	None	None	Colorific, CustoMax	None	Colorific
3 years	3 years	3 years	3 years	3 years	3 years	3 years	3 years	3 years (CRT, 2 years)	3 years
Next day	None	Corporate plan	Next day	None	None	Next day	None	Corporate plan	None
8:00-8:00 M-F	9:00-8:00 M-F	8:00-8:00 M-F	8:00 A.M.-8:30 P.M. M-F	8:00-8:00 M-F	8:30-5:00 M-F	24 hours, 7 days	8:00-8:00 M-F	8:00 A.M.-9:00 P.M. M-F, 9:00-5:00 Sat.	10:00-9:00 M-F
www.iiyama.com	www.magnnvision.com	www.mitsubishi-display.com	www.nec.com	www.nokia.com	www.nsa-hitachi.com	www.panasonic.com/alive	www.philipsmonitors.com	www.sony.com/technology	www.viewsonic.com

CAD professionals, yet affordable enough for corporate desktops.

Based on a 21-inch DiamondTron (or what ViewSonic calls SonicTron) aperture grille tube with an 0.28-mm mask pitch, the PT813 can deliver 1,600-by-1,200 resolution at a good 85 Hz. You're required to run software to install the Plug and Play features of the PT813, which seems a little contradictory. But the setup instructions are clear, and once the software is installed, display configuration and adjustment is a breeze. Among the advanced controls are moiré cancellation, horizontal and vertical convergence control, and both horizontal and vertical focus.

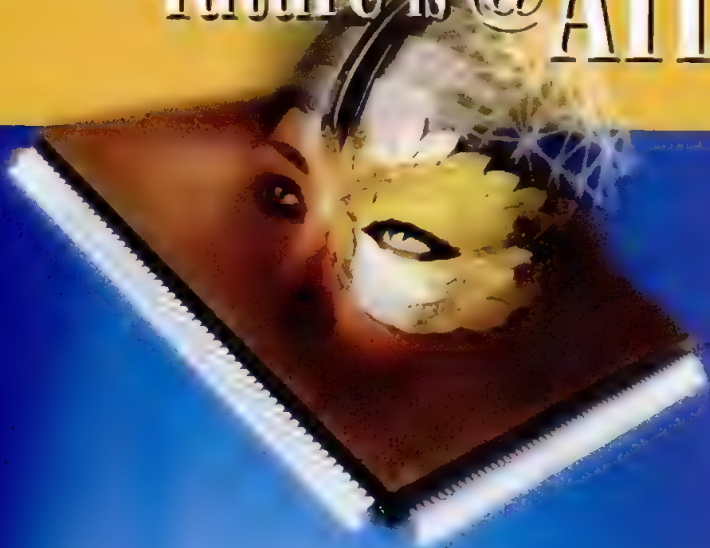
The PT813's top performance scores were confirmed in our subjective evaluation. Brightness, color, resolution, and focus uniformity were all right on the money. Minor moiré patterning was easily canceled by the user controls. Top performance and user friendliness at a moderate price cost make the ViewSonic PT813 unbeatable for all big-screen applications. □

Contacting the Vendors

- APPLE COMPUTER INC., CUPERTINO, CA;
800-482-4386, 408-996-1010;
www.powermacintosh.apple.com/displays.
Circle 503 on reader service card.
- COMPAQ COMPUTER CORP., HOUSTON;
800-345-1518, 713-514-0484;
www.compaq.com.
Circle 504 on reader service card.
- CORNERSTONE IMAGING INC., SAN JOSE, CA;
800-582-2552, 408-435-8900;
www.corimage.com.
Circle 505 on reader service card.
- DELL COMPUTER CORP., AUSTIN, TX;
800-727-8320, 512-338-4400;
www.dell.com.
Circle 506 on reader service card.
- EIZO NANAO TECHNOLOGIES INC., CYPRESS, CA;
800-800-5202, 310-431-5011;
www.eizo.com.
Circle 507 on reader service card.
- GATEWAY 2000 INC., NORTH SIOUX CITY, SD;
800-848-2000, 805-232-2000;
www.gw2k.com.
Circle 508 on reader service card.
- IBM CORP., RALEIGH, NC;
800-428-2968;
www.pc.ibm.com/monitors.
Circle 509 on reader service card.
- IIYAMA NORTH AMERICA INC., COSTA MESA, CA;
800-313-4335, 215-957-6543;
www.iiyama.com.
Circle 510 on reader service card.

- MAG INNOVISION, SANTA ANNA, CA; 800-827-3928, 714-751-2004;
www.magnnvision.com.
Circle 511 on reader service card.
- MITSUBISHI ELECTRONICS AMERICA INC., CYPRESS, CA;
800-843-2515, 714-220-2500;
www.mitsubishi-display.com.
Circle 512 on reader service card.
- NEC TECHNOLOGIES INC., ITASCA, IL;
800-632-4636, 630-775-7900;
www.nec.com.
Circle 513 on reader service card.
- NOKIA DISPLAY PRODUCTS INC., SAUSALITO, CA;
800-296-6542, 415-331-0322;
www.nokia.com.
Circle 514 on reader service card.
- NSA/HITACHI, WESTWOOD, MA; 800-441-4832, 617-461-8300;
www.nsa-hitachi.com.
Circle 515 on reader service card.
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www.philipsmonitors.com.
Circle 517 on reader service card.
- SONY ELECTRONICS INC., SAN JOSE, CA; 800-352-7689;
www.sony.com/technology.
Circle 518 on reader service card.
- VIEWSONIC CORP., WALNUT, CA; 800-888-8583, 909-889-7978;
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GRAPHICS ACCELERATORS

PC Labs reviews 20 sub-\$300 graphics accelerators with 2-D and 3-D capabilities using the new ZD 3D Graphics WinMark benchmark test suite.

3D SHOWDOWN

By Jan Ozer

This will be remembered as the year that 2-D Windows graphics acceleration largely became a nonissue for mainstream business applications, now that the 2-D performance of the fastest and slowest graphics accelerator boards can barely be perceived by most users during their day-to-day word processing, spreadsheet and communications tasks. For business and home users who are buying today with an eye toward the future, the focus must turn toward the next frontier: 3-D graphics speed and quality.

So far, 3-D graphics—rendering scenes and images with a lifelike sense of depth—have been about games. Popular titles such as *Mech Warrior 2* and *Monster Truck Rally* used 3-D landscapes and 3-D rendering effects to draw players into their worlds.

Later this year, business users

will be confronted by the first productivity applications to offer 3-D functionality. While programs such as Excel let you generate 3-D graphs and charts, the next generation of business applications will use 3-D to create representations of data to express a higher level of detailed information at a glance. For instance, the quarterly statements from 50 stores could be viewed on a 3-D map of the country. You



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Experience the interactive version of "3D Showdown" at our Web site and see more scenes rendered in 3-D

<http://www.zdnet.com>

could even include statements from previous years by assigning them coordinates further away in the z-axis.

And on the Web, the current 3-D spinning logos and the like will give way to more useful 3-D objects, such as products you can view from all sides, and homes, vacation destinations, and other environments you can walk around in. You will be able to get these benefits from the software-only acceleration built into Windows, but the screen redraws will be painfully slow.

REVIEW CRITERIA

In this roundup we focus on graphics accelerator boards targeted at mainstream business and home PC users. To be included, a board had to deliver Windows 95 2-D and 3-D acceleration at 1,024-by-768 resolution, 16-bit color depth, and a refresh rate of at least 85 Hz, the current minimum refresh-rate standard endorsed by the Video Electronics Standards Association (VESA). We also required at least 4MB of RAM, so the board could deliver 1,024-by-768 resolution at 24-bit color depth (also called *true color*) and still have the bandwidth to handle the extra memory demands of 3-D. The board had to have a street price of \$300 or less and be new to the market since our last review of mainstream accelerators ("3-D for Free," December 3, 1996), though we invited back two Editors' Choice winners from that roundup to see how they compare with the newer competition.

Fifteen vendors submitted a total of 20 boards, ranging from \$75 (for Genoa's Phantom 3-D) to \$300 (for entries from ELSA and Leadtek). More than half of the boards were powered by S3's popular ViRGE chip set, including three with the newly released ViRGE DX chip—though as it turns out, popularity didn't equate with 3-D performance. Three boards were based on the Cirrus Logic GD5464 chip and three on Rendition's Verite V1000. One board was based on 3Dlabs' Permedia chip. ATI and Matrox debuted new versions of their 3-D chip sets, the

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ATI 3D Rage II+ DVD and Matrox MGA 1164 SG.

ZD'S NEW 3D WINBENCH

Since the 1990 introduction of the first dedicated graphics processor for Windows, chip and board makers have played a game of leapfrog, steadily improving 2-D graphics performance. Now we've seen the one-upmanship in the 2-D arena level off at mainstream resolutions and color depths.

The performance differences it found among boards were significant—sometimes more than 3:1.

Our 3D Graphics WinMark suite is a Direct3D application; it measures how well a chip accelerates the specific functions defined in Microsoft's Direct3D specification. Briefly, Direct3D (commonly referred to as D3D) is an application programming interface (API) that standardizes communication between programs exercising 3-D functions and the graphics hardware that provides the functions. By supporting D3D, all 3-D applications should work seamlessly with all graphics cards that supply D3D drivers, including all the boards in this review.

To get the benefits of D3D, your system must have the D3D software subsystem (a component of Microsoft's DirectX development libraries) installed; most 3-D board vendors include it. When you load a game or application that requires D3D, the software queries your system to see if the proper level of D3D support is present. If it is, the software will take advantage of the hardware-assisted acceleration; otherwise the application defaults to software acceleration, which will run the application—but much more slowly.

This setup is an all-or-nothing affair. The application software cannot use hardware acceleration for some functions and software emulation for others. It must decide up front whether to use hardware or software acceleration, and this can affect



BRAVE NEW 3-D WORLDS Mainstream 3-D applications are on the way. Look for modeling and animation packages that don't require a graphics workstation and 3-D Web sites that give you a better view of products

Nineteen of the accelerators we tested performed within 2 points of each other on the ZD Business Winstone 97 benchmark tests, which measure 2-D Windows acceleration in popular business applications. Such dif-

the features. If a D3D feature is missing or improperly implemented in hardware, image quality can suffer; if software emulation is used, performance can suffer.

Our new 3D Graphics WinMark suite exercises many of the functions defined in the Direct3D specification, measuring the number of frames displayed per second during the playback of carefully tailored 3-D sequences. It also takes into account the quality of the 3-D rendering modes—fog, transparency, specular highlighting, and more—for 3-D scenes. The result is expressed as a 3D Graphics WinMark score, which represents an arithmetic average of the results produced by the ten tests.

MEASURING UP

The 3D Graphics WinMark scores of boards in this review ranged from a low of 20 for Diamond's ViRGE VX-based Stealth 3D 3000XL (\$180 street) to a high of 64 for Leadtek's WinFast 3D L2200 (\$300 street), based on the Permedia chip from 3DLabs. The 11 boards based on the ViRGE chip lines generally score at or near the top on our 2-D benchmark tests, but landed at the bottom on the 3-D tests. After the Leadtek, three boards (from Canopus, Sierra, and Intergraph) built around the Rendition Verite V1000 chip proved fastest in 3-D acceleration.

What does this mean for your real-world experience? Performance will vary based on the 3-D features used by the specific game or application, but on some of our tests the lowest-scoring board played scenes at 5 frames per second, while the fastest board produced over 30 fps—a staggering difference.

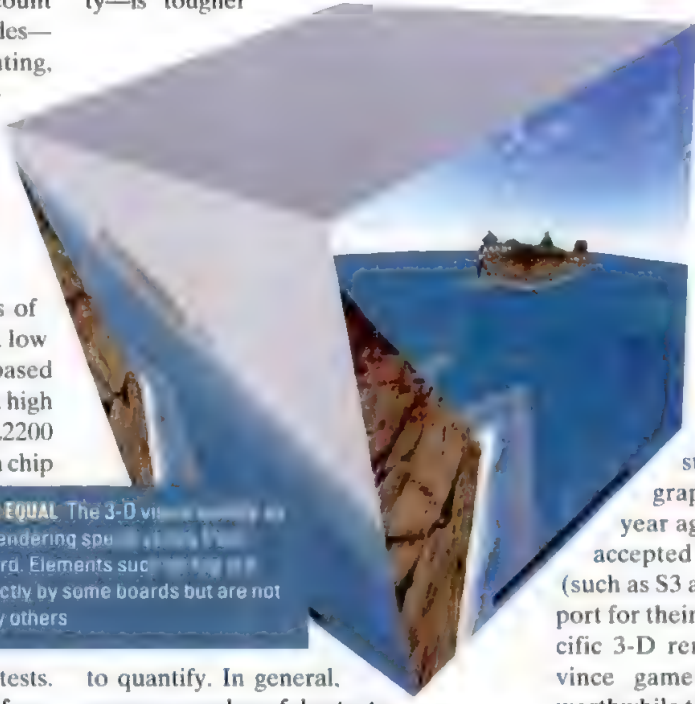
The subjective side—3-D visual quality—is tougher

Matrox Mystique 220, for example, which uses hardware acceleration, does not support bilinear texture filtering or fog; scenes that call for these effects are simply rendered without them.

API ISSUES

The most significant news on the API front is Microsoft's announcement of DirectX 5.0, a broad-based specification that defines Windows-based multimedia file formats and APIs for games and other programs that interface with graphics boards, sound cards, and input devices (such as mice and joysticks). While DirectX 5.0 affects many areas of media development and playback, it's particularly relevant to Direct3D.

Though D3D is now supported by all mainstream graphics board vendors, just a year ago there was no universally accepted API. Larger companies (such as S3 and ATI) had to solicit support for their own proprietary, chip-specific 3-D rendering schemes and convince game developers that it was worthwhile to port popular titles to their chip platforms. This helped create a good deal of confusion in the marketplace as to which games would run with which



NOT CREATED EQUAL The 3-D visual quality as well as the rendering speed varies from board to board. Elements such as fog and transparency are drawn correctly by some boards but are not supported by others

to quantify. In general, we saw a number of shortcuts taken and effects improperly or incompletely implemented, all of which affected the quality of the rendered images. The

Editors' Choice

• ATI All-In-Wonder



The 2-D graphics performance of the majority of accelerators in this review is now so good, you can pay closer attention

to a board's other attributes, particularly 3-D acceleration and creature comforts.

The All-In-Wonder (\$290 street), from ATI Technologies, is a breakthrough product and wins Editors' Choice. The board delivers top-tier 2-D and good 3-D acceleration with ATI's own 3D Rage II+ DVD chip, so users have a board for today's 2-D Windows applications and the coming wave of Direct3D-enabled apps. But ATI has gone further by including a range of features that add value for business and home PC users. The board has built-in video-capture capabilities and an on-board TV tuner. The included software can capture closed-

caption information in broadcasts as a text file or scan the incoming text for key topics. Painless install and a good software bundle round out this winning package.

For business users looking for a more affordable board primarily for traditional 2-D Windows acceleration, four boards are front-runners and deserve honorable mention: the Diamond Stealth 3D 2000XL Pro (\$135), the Hercules Terminator 3D/DX (\$150), the Matrox Mystique 220 (\$180), and the STB Nitro 3D (\$150). They all deliver excellent 2-D performance, hassle-free installation, and handy display utilities. Note that their 3-D performance and the visual quality of their 3-D-rendered scenes is not state-of-the-art, so you may need to upgrade in a year if the applications you use begin to demand better 3-D support.

Finally, if 3-D fun tops your list, consider the Total 3D bundle (\$260 street) from newcomer Canopus, which also merits honorable mention. The Rendition Verite V1000-based board delivered the second-best 3-D acceleration in this review, as well as top-tier 2-D performance. Canopus, too, has gone the extra mile by including a strong software bundle, stereoscopic glasses, and a software utility that lets you turn any electronic image into a 3-D image on-screen.

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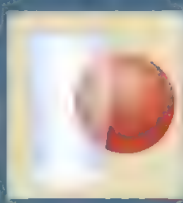
Has It Changed Your Life Yet?

*As a trademark of Intel Corporation. *Upgrade planned for year end. The K56flex protocol is designed only to allow faster downloads from K56flex compliant digital sources. Maximum achievable download transmission rates are currently unknown.

3-D Terminology

Alpha blending

to show if



Bilinear filtering

smooths texture

to lessen the blocky effect

Direct3D

Microsoft

API

for 3-D

graphics

programming

and

rendering

on

Windows

NT

and

Mac

OS

X

platforms

for

3-D

graphics

acceleration

and

rendering

on

Windows

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OS

X

platforms

for

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graphics

acceleration

and

rendering

on

Windows

NT

and

Mac

OS

X

platforms

MIP (multum in parvum) mapping uses

different resolut

on an object's texture

Specular highlighting

from a light source on an object

Texture mapping ap

bricks on a v

Z-buffering



graphics boards, and how well.

In DirectX 5.0, Microsoft extended D3D to include more features and make writing to the D3D API easier. For example, DirectX 5.0 supports the Draw Primitive API, which shields the developer from having to write an execute buffer for each 3-D object in a scene. Draw Primitive is what 3-D programmers will use to add 3-D functionality to their extant applications; it should hasten the availability of 3-D-enabled applications outside the game arena.

BUYING TODAY FOR TOMORROW

First, the bad news: 3-D acceleration technology is still in its infancy, and advances are coming fast and furious. Like the leapfrog game in the 2-D acceleration race of yore, every six months sees a doubling of performance. Beta chip sets are now being shown that far exceed the capabilities of the brand-new boards in this review (see the sidebar "3-D Breakthroughs Around the Corner"). Still, if you need to commit today, there are several factors to consider in addition to 3-D performance.

Most important is making sure the board can deliver an acceptable refresh rate at the resolution and color depth you use. Users of larger monitors (17 inches and up) will need a higher-bandwidth (and more expensive) board that can handle 1,024-by-768 resolution or better, at a color depth you can live with, and still maintain a refresh rate of at least 85 Hz.

Three of the vendors offer TV tuner add-on daughtercards (\$75 to \$129 list) for their boards that let you connect an antenna or cable feed. Beyond allowing you to have CNN (or the big game) playing in a window while you work, these cards can scan and store the closed-caption text stream and alert you if a topic of interest is discussed.

ATI has taken the concept one step further with the All-In-Wonder board (\$290 street). It features an on-board TV tuner (no extra card need-

ed) plus analog video output, which allows you to send your PC signal to just about any television set. In addition to allowing you to play computer-based games on your much larger television set, an All-In-Wonder-equipped PC (or one with ATI's other entry here, the \$235 3D Graphics Pro Turbo PC2TV) can be used in a conference room to play presentations on a TV set. These next-generation extras, plus fine 2-D and 3-D acceleration, make the All-In-Wonder our Editors' Choice.

Graphics cards affect your computing experience more than any other peripheral. Buy today for the best 3-D experience ever offered. But do it knowing you may need to buy again in 18 to 24 months to leverage the advances that are right around the corner.

ATI TECHNOLOGIES INC.

3D Pro Turbo PC2TV,
All-In-Wonder

ATI's 3D Pro Turbo PC2TV (\$279 list, \$240 street) and All-In-Wonder (\$329 list, \$290 street) both deliver fast 2-D and 3-D performance, top-notch video playback, and support a host of Direct3D modes. The 3D Pro Turbo PC2TV's high refresh rate and support for up to 8MB of RAM will appeal to business users. The All-In-Wonder delivers several unique functions that may become standard on accelerator boards in the future. It is our Editors' Choice.

The boards, based on ATI's own 3D Rage II+ DVD chip, share a well-designed CD-ROM-based installation procedure that features a setup wizard, easy-

SUITABILITY TO TASK

All-In-Wonder

2-D performance	Excellent
3-D performance	Good
3-D visual quality	Excellent
Creature comforts	Excellent

3D Pro Turbo PC2TV

2-D performance	Excellent
3-D performance	Good
3-D visual quality	Excellent
Creature comforts	Excellent





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DESKTOP MANAGERS

How to Read the Suitability to Task Boxes

In **2-D performance**, a rating of **excellent** indicates that the board was in the top tier of our ZD Business Winstone 97 test suite and showed no 2-D image anomalies. Boards that placed in the second tier earned a rating of **good**. Third-tier boards, whose performance lags the leaders but is still adequate for most day-to-day chores, earned a rating of **fair**. No boards in this review had 2-D performance that earned a **poor**.

To score well in **3-D performance**, a board had to rank at or near the top in our new 3D Graphics WinMark test suite. Support for a range of Direct3D features helped a board's score, while

incomplete or improper feature support detracted from it.

For **3-D visual quality**, we inspected various 3-D-rendered scenes to see how well features and effects—texture mapping, transparency, fog, specular highlighting—were implemented.

For **creature comforts**, we considered the added-value extras that a board vendor delivers with the product. Is the installation intuitive and hassle-free, for example? We also evaluated the quality and usefulness of the board's display utilities, as well as the included software bundle.

to-understand screens, and context-sensitive help files.

The All-In-Wonder is the single-slot answer to all your display needs. It combines excellent 2-D and 3-D acceleration with built-in video capture capability and a TV tuner. The TV tuner lets you capture a closed-caption text string to your hard disk; you can schedule text recording or be alerted if specified keywords (such as *stock market* and *crash*) are found. The All-In-Wonder bundles PhotoSuite and MechWarrior 2, Macromedia Director 4.0, and a full version of Vream's WIRL VRML browser for viewing 3-D Web sites.

The Pro Turbo PC2TV supports 1,600-by-1,200 resolution at 85 Hz in high-color mode (65,000 colors), ideal for business users working on large-screen monitors. Even better, the board includes an TV-out jack so you can display computer images on a TV set for presentations or home-theater gaming. The Pro Turbo PC2TV comes with Macromedia's Extreme 3D (a 3-D modeling and animation package), PhotoSuite 3.5, and a 3D Rage-tuned version of MechWarrior 2.

Both products were excellent performers on our 2-D and 3-D benchmark tests. They placed near the top on our ZD Business Winstone 97 tests, and fifth and sixth

on our 3D Graphics WinMark suite. They are currently the only shipping products that truly support MIP-mapped textures with hardware. However, like many of the others we tested, both boards had trouble supporting fog and transparency modes simultaneously.

These are formidable products. For sheer versatility, the All-In-Wonder is tough to beat, and for excellent usability at high resolutions and an 8MB option, the 3D Pro Turbo PC2TV is a worthy board in its own right.—*Jon Hill*

3D Pro Turbo PC2TV. List price: \$279. **All-In-Wonder.** List price: \$329. ATI Technologies Inc., Thornhill, Ontario, Canada; 905-882-2600; www.atitech.ca. **Circle 521 on reader service card.**

CANOPUS CORP. **Total 3D**

Canopus Corp.'s Total 3D (\$279 list, \$260 street) is the perfect graphics adapter for those seeking arcade-quality gaming right out of the box. The board, based on the Rendition Verite V1000 chip, is packaged with virtual-reality glasses and a great software bundle.

The Total 3D delivered excellent 2-D and 3-D acceleration. If you're looking for a gaming package, you can stop here.

In addition to support for the bundled 3D Spex stereoscopic glasses (from Nu-Vision), the board contains an audio post-processor that converts 2-D audio to 3-D, and ActiveMovie for MPEG-1 playback. The bundle includes four games: the shareware version of Quake and full versions of IndyCar Racing II, Descent II: Destination Quartzon, and Whiplash 3D.

Complementing the hardware is a surprisingly mature set of graphics utilities for such a new product. There are color and brightness adjustments, and Canopus's Total Cinema video utility makes the most of the V1000's scaling engine, which produced clear, artifact-free MPEG-1 and AVI video. The board and accompanying glasses created a high-quality 3-D environment and quickly became a favorite in our labs.

The Total 3D placed among the top performers on our ZD Business Winstone 97 suite, and ranked second on our 3D Graphics WinMark test suite (behind the Permedia-based Leadtek WinFast 3D L2200). The only disappointment is the



Total 3D's lack of support for MIP-mapping and specular highlighting.

The Total 3D bundle is sure to please fast-twitch gamers; it should also appeal to business users who require high resolution and 24-bit color for desktop applications—and who like to play after hours.—*Jan Ozer*
Total 3D. List price: \$279. Canopus Corp., San Jose, CA; 888-868-2533, 408-467-4000; www.total3d.com. **Circle 522 on reader service card.**

Our Contributors: JAN OZER, JOHN R. QUAIN, and WINN L. ROSCH are contributing editors of *PC Magazine*. JON HILL is a frequent contributor to the magazine. ROB GLIDDEN is a senior contributing editor to *Wave*, a newsletter that covers 3-D and media technologies. JAMIE M. BSALES was the associate editor in charge of this story, and JEFF MACE was the project leader.

BENCHMARK TESTS

Graphics Cards



Our tests reveal that 2-D acceleration under Windows 95 is a done technology. If great 2-D is what you need, most of these boards can deliver it. On the other hand, our new ZD 3D Graphics WinMark test suite shows that 3-D optimization still has miles to go.

What the Numbers Mean

2-D PERFORMANCE ANALYSIS As a whole, the performance of 2-D graphics accelerators has leveled off and is no longer a viable differentiator for products. All the boards we tested delivered excellent 2-D performance except for the 3Dlabs Permedia-based board, which is built expressly for 3-D gaming. While a vendor might choose to highlight a board's high ZD Business Graphics WinMark 97 score, it means little: 3-D performance is the ultimate proving ground.

Although two boards—the Genoa Phantom 3D/DX and the VideoLogic GraftixStar 750—tied with a top Winstone score of 38.6, we consider all boards that scored above 37 comparable performers because Winstone 97's margin of error is ± 1.5 points,

which we round up to the next nearest whole number.

Note that 3D Graphics WinMark results vary considerably against Winstone 97 scores. The 3D Graphics WinMark detects subtle performance differences that won't necessarily translate into end-user experience. A 10- to 15-point 3D Graphics WinMark spread won't reflect performance differences at current system performance levels, so be wary of ads that boast speed differences within this range. For an accurate picture of a board's performance, always view both sets of test results side by side.

GDI BYPASSING FADES AWAY There's another reason why 2-D performance was so close: Under Windows 95, there are few improvements for the board vendors to make once they've optimized the drivers. To gain a competitive edge, board vendors have latched onto optimization schemes to increase Graphics WinMark numbers, such as GDI bypassing. This scheme bypasses the processing path required by the Windows GDI (graphical device interface) operating system. (For more on GDI bypassing, see Lab Notes, December 3, 1996, or go to www.pcmag.com/pclabs/report/.)

Microsoft has done little to improve the Windows GDI. Much of the code is 16-bit, and some predates Windows 3.0. There are good reasons for this, however. The GDI needs to be compatible with over 40,000 applications, several of which are old by today's standards. Because GDI bypassing may make the operating system unstable, Microsoft won't certify a product that enables GDI bypassing to be Windows 95-compatible.

The Graphics WinMark and Winstone 97 chart on this page illustrates the effect of GDI bypassing on Graphics WinMark scores. The Matrox Mystique 220's score increased by 4 points, and the Stealth 3D 2000XL Pro's jumped by 11. However, Winstone 97

2-D BENCHMARK TESTS

Board type denotes first place.	Graphics Chip	ZD Business Winstone 97		ZD Business Graphics WinMark 97		ZD Business Winstone 97		ZD Business Graphics WinMark 97	
		(GDI bypass off)		(GDI bypass off)		(GDI bypass on; not recommended)		(GDI bypass on; not recommended)	
ATI 3D Pro Turbo PC2TV	ATI 3D Rage II+ DVD	38		61		N/A		N/A	
ATI All-In-Wonder	ATI 3D Rage II+ DVD	38		59		N/A		N/A	
Cantopus Total3D	Rendition V1000L	37		51		N/A		N/A	
Creative Labs Graphics Blaster 3D	Cirrus Logic GD5464	37		50		37		50	
Diamond Stealth 3D 2000XL	S3 VIRGE	38		46		39		62	
Diamond Stealth 3D 2000XL Pro	S3 VIRGE DX	38		61		39		72	
Diamond Stealth 3D 3000XL	S3 VIRGE VX	38		58		38		58	
ELSA Winner 2000AVI/3D	S3 VIRGE VX	38		59		N/A		N/A	
ELSA Winner 3000-M	S3 VIRGE VX	38		53		N/A		N/A	
Genoa Phantom 3D/DX	S3 VIRGE DX	38		59		N/A		N/A	
Hercules Terminator 3D/DX	S3 VIRGE DX	38		59		N/A		N/A	
Intergraph Intense 3D 100	Rendition V1000	37		46		N/A		N/A	
Leadtek WinFast 3D L2200	3Dlabs Permedia NT	35		39		N/A		N/A	
Matrox Mystique 220	MGA-1164SG	38		60		38		64	
Number Nine 9FX Reality 772	S3 VIRGE VX	38		57		38		58	
Sierra On-Line Screenin' 3D	Rendition V1000	37		50		N/A		N/A	
STU Nitro 3D	S3 VIRGE GX	38		59		N/A		N/A	
TechWorks Ultimate 3D	Cirrus Logic GD5464	37		50		N/A		N/A	
VideoLogic GraftixStar 550	Cirrus Logic GD5464	37		45		N/A		N/A	
VideoLogic GraftixStar 750	S3 VIRGE VX	38		58		38		57	

N/A—Not applicable: This product does not bypass GDI

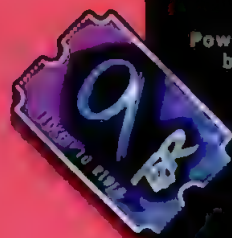
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WinBench '97 Business Graphics tests conducted on a Pentium II 366MHz, 512K cache, 32MB SDRAM at 1024x768x32bpp @ 75Hz vertical refresh, under Microsoft Windows NT Build 1381 Service Pack 2. Number Nine Revolution™ 3D, Matrox Millennium™ and Mystique™ were configured with 4MB of memory using a minimum of 100MHz, 32-bit and full-resolution.

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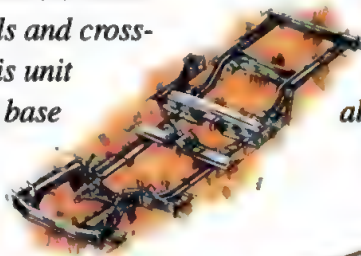
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BENCHMARK TESTS

scores were not improved by GDI bypassing, and we continue to assert that it offers no end-user benefit. Moreover, with each new roundup, fewer vendors are using bypassing drivers. ATI and STB have abandoned the practice altogether, and PC vendors such as Dell refuse to put bypassing-enabled boards in their systems.

VIDEO IN TRANSITION None of the boards we tested dropped frames on our Indeo AVI playback tests. Expect this to change, however, as proprietary MPEG decoders become increasingly supplanted by Active Movie—the new Windows multimedia player—as the default video file player. While MPEG decoders use proprietary drivers to engage the board's video scaling and color-space conversion algorithms, most vendors have yet to integrate Active Movie to work with their boards. Active Movie is available on the Microsoft Web site (www.microsoft.com) and is installed on most new computers as a part of OSR/2.

3-D DUST SETTLES Optimizations for 3-D performance are going to take some time, as mainstream vendors learn to ride this new technology as far as they have taken 2-D. Before the release of the new ZD 3D Graphics WinMark suite (which debuts in this roundup), vendors' claims for 3-D features and performance were as wild as the early west. 3-D Graphics WinMark clarifies which 3-D features are important and gauges how well they are implemented.

We were surprised to find that many 3-D rendering modes were supported by the chip set but improperly implemented (or engaged at all) by the software driver. This was true (to a varying extent) for all the boards except our reference board, the 3DFX-

based Hercules Stingray, which excelled on all our tests. Vendors claimed that their boards supported features (such as MIP mapping and specular highlighting) that failed under Direct3D, Version 3a, probably due to an either flawed or unfinished implementation in the driver (or chip).

The Interactive 3-D Quality tests determined which 3-D modes were correctly supported by the board. If a board supports the rendering modes required by a test scene in hardware, it uses the HAL (hardware abstraction layer) driver, which boosts performance. If the mode is not supported or is improperly supported, the board uses the HEL (hardware emulation) driver and renders the scene in software. Note that when the Matrox Mystique 220 was forced to use the HEL for lack of 3-D mode support, it slowed to less than one frame per second on the Low- and Medium-Complexity Space Station tests. But when it used the HAL for the Lowest Complexity Space Station and Low-Complexity Race Track, performance jumped to 24.5 and 13.2 fps, respectively. On any board in this review, scenes run under the HEL ran at less than 1 fps.

The 3D Graphics WinMark score is based on the compilation of ten 3-D rendering tests. Therefore, running the tests in software decreases the board's overall score. Likewise, boards that support the greatest number of features in hardware gain the performance advantage. For example, the only boards to support MIP-mapped bilinear filtering were the ATI boards and the 3DFX reference board. (For a complete description of our 3-D

3-D BENCHMARK TESTS

		ZD 3D Graphics WinMark	Point Sampling				Bilinear Filtering			MIP Mapping		
			Very low-com- plexity space station	Low- complexity racetrack	High- complexity chapel	Low-com- plexity space station	Medium-com- plexity space station	High-com- plexity islands	High-com- plexity chapel	Very high- complexity islands	Very high- complexity chapel	Very high-com- plexity space station
ATI 3D Pro Turbo PC2TV	ATI 3D Rage II+ DVD	46.0	14.5	8.8	3.2	7.7	0.8	0.8	2.9	3.8	2.9	3.9
ATI All-In-Wonder	ATI 3D Rage II+ DVD	43.5	13.8	8.4	3.1	7.2	0.8	0.8	2.8	3.3	2.8	3.7
Canopus Total 3D	Rendition V1000L	53.5	17.6	12.3	4.5	13.1	0.8	4.3	4.5	N/A	N/A	N/A
Creative Labs Graphics Blaster 3D	Cirrus Logic GD5464	32.7	12.3	7.5	2.8	8.3	0.8	0.7	2.7	N/A	N/A	N/A
Diamond Stealth 3D 2000XL	S3 VIRGE	22.7	8.5	2.8	2.9	5.8	0.8	0.8	2.7	N/A	N/A	N/A
Diamond Stealth 3D 2000XL Pro	S3 VIRGE DX	30.6	13.8	2.8	3.6	7.8	0.8	0.8	3.2	N/A	N/A	N/A
Diamond Stealth 3D 3000XL	S3 VIRGE VX	20.4	7.2	2.8	2.8	4.9	0.8	0.8	2.5	N/A	N/A	N/A
ELSA Winner 2000AVI/3D	S3 VIRGE VX	26.3	8.6	5.5	2.6	5.8	0.8	2.5	2.4	N/A	N/A	N/A
ELSA Winner 3000-M	S3 VIRGE VX	21.2	8.0	2.8	2.5	5.5	0.8	0.8	2.3	N/A	N/A	N/A
Genoa Phantom 3D	S3 VIRGE DX	27.3	12.7	2.8	3.0	6.7	0.8	0.8	2.5	N/A	N/A	N/A
Hercules Terminator 3D/DX	S3 VIRGE DX	28.7	12.3	2.8	2.9	6.5	0.8	0.8	2.4	N/A	N/A	N/A
Intergraph Intense 3D 100	Rendition V1000	47.8	14.9	11.1	4.5	11.3	0.8	4.1	4.4	N/A	N/A	N/A
Leadtek WinFast 3D L2200	3Dlabs Permedia NT	63.8	20.3	13.1	4.4	12.3	9.9	4.2	4.1	N/A	N/A	N/A
Matrox Mystique 220	MGA-116 4SG	41.7	24.5	13.2	4.0	0.8	0.8	0.8	0.6	N/A	N/A	N/A
Number Nine 9FX Reality 772	S3 VIRGE VX	21.5	8.3	2.8	2.8	5.1	0.8	0.8	2.5	N/A	N/A	N/A
Sierra On-line Screamin' 3D	Rendition V1000	48.0	14.9	11.2	4.5	11.3	0.8	4.1	4.5	N/A	N/A	N/A
STB Nitro 3D	S3 VIRGE GX	31.9	15.0	2.8	3.6	8.2	0.8	0.8	3.1	N/A	N/A	N/A
TechWorks Ultimate 3D	Cirrus Logic GD5464	33.0	12.5	7.5	2.8	8.3	0.8	0.7	2.7	N/A	N/A	N/A
Videologic GraftixStar 550	Cirrus Logic GD5464	33.5	12.7	7.6	2.8	8.4	0.8	0.8	2.7	N/A	N/A	N/A
Videologic GraftixStar 750	S3 VIRGE VX	23.1	9.2	2.8	2.9	5.7	0.8	0.8	2.6	N/A	N/A	N/A
Hercules Stingray*	3DFX	105.6	31.9	16.0	4.6	19.0	13.3	5.8	4.6	5.8	4.6	7.2

N/A—Not applicable. This product does not support MIP-mapped texture filtering. * Reported for comparison, the Hercules Stingray, now in beta, uses a 3DFX and Alliance chip-set combination.

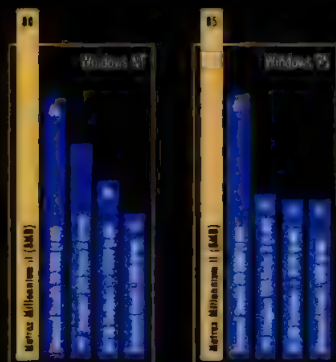
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* Estimated street prices. Software bundle available only with retail product. All performance tests conducted by Matrox Graphics Inc. Windows NT 4.0 tests conducted on a Dell Pentium Pro 200 MHz with 32 MB of EDO RAM and 256K cache. Matrox Millennium II, Diamond Stealth 3D 3000, Number Nine Imagine 128 series 2, ATI 3D ProTurbo-PC2TV and Diamond FireGL 1000 tested using driver releases 3.06, 2.03, 4.102.21, 3.1.75 and 2.70.4.0.27 respectively. Windows 95 testing was done on a Gateway 200 MHz MMX with 32 MB of RAM and 512K cache using driver releases 3.61, 4.03.00.3105, 2.13, 3.03 and 4.03.00.2101.0008 respectively. All boards tested were configured with maximum memory configurations. Winbench 97 business tests conducted at 1024 x 768 @24-bit at 75 Hz using small fonts under Windows NT 4.0 and 95.

BENCHMARK TESTS

Graphics WinMark test suite, see "A New Standard in Windows 3-D Testing" in the Lab Notes section of this issue.)

Although boards that support 3-D rendering modes in hardware were faster performers, our tests disclosed rough edges that impacted image quality in nearly all of the boards' drivers. For example, the S3 ViRGE VX-based boards rendered textures inaccurately in our Chapel scene, which contains textures mapped to polygons describing walls, ceiling, and floors (some triangles appeared smeared). However, the ViRGE DX and GX boards didn't exhibit this problem. In contrast, the Cirrus Logic GD5464-based boards struggled with texture mapping. (New drivers shipped directly from Cirrus Logic cleared up some of this.) While the company claimed that the chip set supports fog and specular highlighting, the boards we tested didn't do so. Some textures appeared smeared or were mapped incorrectly under Direct 3D.

The 3DLabs Permedia-based board, the Leadtek WinFast 3D L2200, was the top 3-D performer overall (except for our reference 3DFX). Its drivers, however, appeared to gain speed with a decrease in the resolution of the incoming texture, which affected image quality in the Islands scene test. The Matrox Mystique 220 failed most of the 3-D tests, because it doesn't support fog, bilinear filtering, or specular highlighting. Since it doesn't support these features, most of its tests were run in software under the HEL.

Chip sets—except for those on the 3DFX reference board and the Leadtek WinFast 3D L2200—didn't implement specular highlighting correctly. Vendors may have omitted this feature because it requires an extra interpolant to be added into the calculation for determine the correct pixel color.

Except for the ELSA boards, none of the S3 boards supported transparency. The ATI boards were unable to render scenes that

required both transparency and fog simultaneously. Cirrus Logic GD5464-based boards were unable to run the High-Complexity Islands scene because they didn't support fog and supported transparency modes only partially.

How We Tested

We tested the graphics accelerators on a Micron Millennium Pentium 200-MHz machine with 32MB of EDO RAM. Peripherals on the test-bed included a Western Digital 2.1GB hard disk, an 8X Hitachi IDE CD-ROM drive, a Creative Labs Sound Blaster AWE32 synthesizer (on the motherboard) with a 2MB add-on wavetable card, and a Proteon 1392 Plus Token-Ring network adapter. We used a 17-inch MAG Innovision MXP17F monitor with a 75-Hz refresh rate.

We performed all tests under the Windows 95, with the OEM Service Pack 2 release (OSR/2) applied, and DirectX, Version 3a, installed. We ran the Winstone 97 and Graphics WinMark 97 tests twice; the final scores were derived by averaging the two runs. We used the vendor's recommended drivers and installation procedures for all our tests. For the 2-D tests, we configured the display to 1,024-by-768 resolution with 16-bit color. For the 3-D tests, we used 640-by-480 resolution with 16-bit color.

The 3D Graphics WinMark tests fall into three categories—low, medium, and high complexity—based on the number of triangles contained in each scene. Triangles counts were derived by counting the average number of triangles per frame that contribute to the rendered scene; this excludes any triangles entirely outside the view, too small to cover a pixel, or facing away from the camera. The tests support both types of transparency: alpha blending and color keying. If one is not supported, the test tries the other.—*Analysis written by Jeff Mace*

CREATIVE LABS INC. Graphics Blaster 3D

Creative Labs made a name for itself by providing home game players with inexpensive entertainment-oriented peripherals. In the same vein comes the Graphics Blaster 3D, the second-lowest-priced board we tested. Based on the Cirrus Logic GD5464 chip, the Graphics Blaster's 2-D and 3-D performance won't astound. But

the \$99 price (list and street) from a well-known name is tough to overlook.

Installation was painless. The board includes loads of software add-ins such as Vream's WIRL VRML 1.0 browser for viewing 3-D sites on the Web. Creative Labs' own controls let you resize and reposition the on-screen image, but the board lacks expansion capabilities for add-ons such as a TV tuner.

The Graphics Blaster won't win any awards for 2-D or 3-D performance. Its scores on our 2D Business Winstone 97 benchmark test suite were a little behind the leaders but still adequate. The board placed in the middle of the pack on our 3D Graphics WinMark suite, though its GD5464 chip powered it ahead of ViRGE-based boards that cost twice as much.

Using the driver that came with our test board produced significant er-

rors in 3-D image rendering, such as jumped images and problems with texture mapping. An updated driver supplied by Creative Labs eliminated many anomalies, though the board still did not support fog or specular highlighting.

Even with such shortcomings, the Graphics Blaster's price is hard to resist. For those installing and managing their own graphics upgrades at home, this may be the board.—*John R. Quain*

Graphics Blaster 3D. List price: \$99. Creative Labs Inc., Milpitas, CA; 800-998-5227; 408-428-6600; www.creativelabs.com. *Circle 523 on reader service card.*

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- Creative Labs VIBRA 16CL Audio Device with 3D Microphone & Stereo Headphones
- Altec Lansing Stereo Speakers
- 15" (13.8" viewable) .28 Dot Pitch Monitor
- APC Pro SurgeArrest Pro7T
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tions, but like all boards based on S3's ViRGE chip, their 3-D performance falls short. While the Stealth boards are ideal for many corporate or SOHO applications, those seeking ultimate 3-D excitement should look elsewhere.

An Editors' Choice in our roundup seven months ago ("3-D for Free," December 3, 1996), the Stealth 3D 2000XL is based on the first-generation ViRGE chip and is targeted at the cost-conscious home or business user. The board provides an 85-Hz refresh rate at 1,024-by-768 resolution in true-color mode (16.7

million colors), which should prove adequate for use on 15- or 17-inch monitors.

The Stealth 2000XL Pro uses the new S3 ViRGE DX chip. The board offers x and y video interpolation as well as TV output, enabling both game play and presentations on large-screen televisions. It's the best Diamond board for video-intensive tasks. Enhanced interpolation, built into the ViRGE DX chip, resulted in noticeably smooth video playback.

At the high end is the Stealth 3D 3000XL, based on the ViRGE VX chip and designed for demanding, large-screen

graphics applications such as image editing and desktop publishing. An 80-Hz maximum refresh rate at 1,600-by-1,200 resolution in high-color mode (65,000 colors) is more than adequate for 17- to 21-inch monitors.

All three boards ship with Compton's Interactive Encyclopedia. The home-oriented 2000XL includes two games, Descent II: Destination Quartzon and Destruction Derby. The 2000XL Pro includes MGI's PhotoSuite SE image editor, SEGA Rally Championship Racing, and Microsoft's Game Sampler 2. The 3000XL

3-D Breakthroughs Around the Corner

by Jon Hill

We tested preproduction boards from Hercules, VideoLogic, and ATI to see what the next generation of mainstream accelerators will deliver. Each takes a different approach to integrating 3-D functionality into a mainstream graphics accelerator, and all three make substantial strides in 3-D performance and image rendering.

Hercules' Stingray 128/3D (\$300 street price) is the first fruit of a collaboration between 3-D-chip specialist 3Dfx and mainstream 2-D-chip maker Alliance Semiconductor. Designed to provide top-flight 2-D, 3-D, and video-playback performance in a single PCI slot, the Stingray relies on the 128-bit Alliance ProMotion 128/3D graphics chip for 2-D and video, while referring 3-D requests to 3Dfx's Voodoo Rush chip set, located on a daughtercard.

We used the Stingray 128/3D as a reference high-end board. The card's performance on the 3D Graphics WinMark tests was compelling. It turned in a score of 105.6 versus 63.8 for the best performer of this roundup.

VideoLogic's Apocalypse 5D (\$280 street price with 8MB of RAM, \$230 with 6MB) demonstrates another multichip approach. The 5D combines Tseng Labs' MDRAM-based ET6000 2-D accelerator with NEC's PowerVR-based PCX2 chip. The Apocalypse 5D is similar in design to the Stingray 128/3D, but with one important difference: It doesn't rely on

z-buffers to render images.

Most 3-D accelerators use z-buffers to store depth information to determine whether a given pixel should be drawn. The PowerVR chip uses an Image Synthesis Processor to remove hidden surfaces in real-time, before applying shading or textures. In theory, this should save memory otherwise

Marked by multichip designs, the next generation of accelerators will significantly improve 3-D image quality and performance.

devoted to z-value storage. Performance is also improved because texture and shading is applied only to visible triangles, which conserves bandwidth.

We tested the 6MB version (2MB of MDRAM plus 4MB of SDRAM for storing textures) of the Apocalypse 5D. Though not as far along in development as the Stingray, the Apocalypse showed distinct promise: The board's 3-D image quality was quite good, and it moved quickly through most of our 3-D Graphics WinMark tests.

ATI has taken a different tack with

the next-generation **3D Rage Pro**. The single-chip accelerator handles all 2-D, 3-D, and video playback requests, adding several features and a big performance boost to the 3D Rage II+ DVD-based boards we reviewed in our roundup. ATI has added a triangle setup engine; improved the perspective correction, fog, and transparency implementations; added support for specular lighting; and enhanced the video playback and DVD support.

The 3D Rage Pro chip is designed with robust support for Intel's Accelerated Graphics Port, which will provide direct, high-speed access to system memory when AGP-enabled motherboards appear. Initial versions will rely on standard graphics memory configurations: up to 8MB of SGRAM or 16MB of WRAM, depending on the model.

The card we looked at was a no-frills 2-D/3-D accelerator. Its 3-D performance surpassed that of ATI's 3D Rage II+ DVD products, and the card processed all our 3-D tests in hardware without anomalies.

Boards based on Rendition's new SGRAM-based Verite 2200 chip are expected to ship by the end of the summer. Rendition claims that the chip will provide twice the 3-D performance of the current Verite and offer major 2-D and video performance gains as well, such as built-in video capture, digital video output, and limited DVD (MPEG-2) support.

HARDWARE

Graphics Accelerators

includes Descent II: Destination Quanton; Asymetrix's 3D F/X, a 3D graphics creation program; and Digital Video Producer (DVP), a digital video editor.

Installation was hassle-free. Diamond's CD-ROM-based installation program ranks among the best. Wizards walk you through configuration choices and include detailed descriptions of the feature set. Because Diamond's utilities (InControl Tools 95) are identical across the product line, volume purchasers can buy all three boards for different types of users, yet minimize the overall support burden.

On our 2-D benchmark tests, all three boards ranked well. Their speed makes them well-equipped to handle the most demanding 2-D tasks. In our subjective 3-D image-quality comparisons, the boards produced high-quality 3-D scenes complete with textures and fog, but performance was poor.

Performance scores on our 3D Graphics WinMark tests were affected by the boards' lack of support for transparency, specular highlighting, and MIP mapping. The DX-based Stealth 2000XL Pro crept into the middle, making it the best 3-D game board of the three, but such performance still placed it far behind the leaders. The 2000XL and 3000XL placed far back in the pack and are tough to recommend for 3-D tasks.

While the three Diamond entries support a variety of applications from word processing to image editing, they're not the best choices for game play. If you're a gamer sold on Diamond, look to Diamond's 3D/FX-based Monster 3D (\$180

street) board, an add-on 3-D only card that delivers a better gaming experience. If you want a top-flight 2-D board, however, the Diamonds deliver.—JO

Stealth 3D 2000XL. List price: \$129.95. **Stealth 3D 2000XL Pro.** List price: \$149.95. **Stealth 3D 3000XL.** List price: \$199.95. Diamond Multimedia Systems Inc., San Jose, CA; 800-468-5846, 408-325-7000; www.diamondmm.com. Circle 524 on reader service card.

ELSA INC.

**Winner 2000AVI/3D,
Winner 3000-M**

Taking a dual approach to the 3-D graphics market, German manufacturer ELSA offers two mainstream boards. The Winner 2000AVI/3D (\$349 list, \$290 street) is designed for business or home use, while the slightly more expensive Winner 3000-M (\$349 list, \$300 street) is intended for budget-conscious CAD designers. While both boards produce respectable-to-good 2-D performance, their 3-D performance was a disappointment, considering the price tags.

The Winner 2000AVI/3D is based on S3's ViRGE VX accelerator and is outfitted with 4MB of EDO VRAM and a 220-MHz RAMDAC. This allows true-color mode (16.7 million colors) up to 1,280-by-1,024 resolution with a 76-Hz refresh rate; High-color mode (65,000 colors) is available at 1,600-by-1,200 resolution at an excellent 85 Hz, which should satisfy users of large-screen monitors.

The board includes a comprehensive set of installation and control utilities and drivers for Microsoft Windows 95, Windows NT, and OS/2 Warp.

Targeted at CAD users, the Winner 3000-M uses the same chip and utilities as its sibling but has a different memory configuration and includes PowerGraph drivers for AutoCAD. The

memory is split between 2MB of EDO DRAM and 2MB of EDO VRAM.

The unusual configuration does limit color support. True color is only available at 800-by-600 resolution; only 256 colors are available at 1,600-by-1,200 resolution with an 85-Hz refresh rate (or 1,280-by-1,024 resolution at 124 Hz).

In standard 2-D applications, both ELSA boards scored well on our ZD Business Winstone 97 benchmark test suite. Video playback was free of ragged artifacts and jerky frame jumps.

Those looking for D3D graphics, however, will encounter the same slow performance as found in the other S3 ViRGE-based boards we tested. The Winner 3000-M, in particular, trailed nearly the entire field, while the Winner 2000AVI/3D bested the other ViRGE VX-based cards in the review but placed in the middle of the pack overall.

If you need high-resolution support, the Winner boards' prices might not seem so high. Still, the lack of a game pack will disappoint home users who are considering the Winner 2000AVI/3D, while professionals won't be enamored with the Winner 3000-M's lackluster 3-D performance.—JRQ

Winner 2000AVI/3D. List price: \$349. **Winner 3000-M.** List price: \$349. ELSA Inc., San Jose, CA; 800-272-3572, 408-935-0350; www.elsa.com. Circle 525 on reader service card.

GENOA SYSTEMS CORP.

Phantom 3D/DX

Bargain hunters take note: The Phantom 3D/DX (\$135 list, \$95 street) is a decent graphics accelerator at a rock-bottom price. The ViRGE DX-based board produced the best 2-D

performance numbers in this roundup and yielded usable 3-D acceleration. Gamers will want to look

Stealth 3D 2000XL		Stealth 3D 2000XL Pro		Stealth 3D 3000XL	
2-D performance	Excellent	2-D performance	Excellent	2-D performance	Excellent
3-D performance	Poor	3-D performance	Fair	3-D performance	Poor
3-D visual quality	Fair	3-D visual quality	Good	3-D visual quality	Fair
Creature comforts	Excellent	Creature comforts	Excellent	Creature comforts	Excellent

SUMMARY OF FEATURES

2-D/3-D Graphics Accelerators

PC MAGAZINE
EDITORS' CHOICE

■ YES ■ NO □ OPTIONAL

Products listed in italics under

	ATI 3D Pro Turbo PC2TV	ATI All-in- Wonder	Canopus Total 3D	Creative Labs Graphics Blaster 3D	Diamond Stealth 3D 2000XL	Diamond Stealth 3D 2000XL Pro	Diamond Stealth 3D 3000GL
List/street price	\$279.00, \$240	\$329.00, \$290	\$279.00, \$260	\$99.00, \$100	\$129.95, \$120	\$149.95, \$140	\$199.95, \$180
Graphics accelerator chip	ATI 3D Rage II+ DVD	ATI 3D Rage II+ DVD	Rendition V1000L	Cirrus GD5464	S3 VIRGE	S3 VIRGE DX	S3 VIRGE VX
Tested/installable display memory	4MB, 8MB	4MB, 4MB	4MB, 4MB	4MB, 4MB	4MB, 4MB	4MB, 4MB	4MB, 4MB
Memory type	SGRAM	EDO DRAM	EDO DRAM	RAMBUS	EDO DRAM	EDO DRAM	VRAM
VGA pass-through connector	■	■	■	■	■	■	■
Maximum noninterlaced graphics resolution (dpi)	1,600 x 1,200	1,600 x 1,200	1,280 x 1,024	1,600 x 1,200	1,280 x 1,024	1,600 x 1,200	1,600 x 1,200
Maximum number of colors at:							
1,600 x 1,200; 1,280 x 1,024	65,000, 16.7 mil.	65,000, 16.7 mil.	N/A, 65,000	256, 65,000	N/A, 65,000	256, 65,000	65,000, 16.7 mil.
1,024 x 768; 800 x 600	16.7 mil., 16.7 mil.	16.7 mil., 16.7 mil.	16.7 mil., 16.7 mil.	16.7 mil., 16.7 mil.	16.7 mil., 16.7 mil.	16.7 mil., 16.7 mil.	16.7 mil., 16.7 mil.
List price for add-on TV tuner	\$129	Included	N/A	N/A	N/A	N/A	N/A
Other add-on options	None	None	None	None	None	None	None

Software and 3-D Features

Drivers for Windows 3.x/95/NT	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Drivers for OS/2, AutoCAD, MicroStation	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
User can reset resolution without rebooting	■	■	■	■	■	■	■
User can reset color depth without rebooting	■	■	■	■	■	■	■
Supports hardware zoom	■	■	■	■	■	■	■
Supports virtual display	■	■	■	■	■	■	■
MPEG playback utility	ATI	ATI	Microsoft ActiveMovie	Soft MPEG	Mediamatics Arcade	Mediamatics Arcade	Mediamatics Arcade
Supports double buffering	■	■	■	■	■	■	■
Supports primitives/triangle strips	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Texture modes supported:							
Point sampling/Bilinear filtering	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Bilinear/trilinear MIP mapping	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Palletized textures/Texture compression	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Atmospheric effects supported:							
Fog/Transparency (alpha blending)	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Specular highlighting/Color-key transparency	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■

Customer Support

Toll-free technical support	■	■	■	■	■	■	■
Technical-support hours (eastern time)	9:00-7:00 M-F	9:00-7:00 M-F	Noon-8:00 M-F	9:00 A.M.-1:00 A.M., 7 days	5:00 A.M.-7:00 P.M. M-F, 8:00-4:00 Sat.	5:00 A.M.-7:00 P.M. M-F, 8:00-4:00 Sat.	5:00 A.M.-7:00 P.M. M-F, 8:00-4:00 Sat.
Web address	www.atitech.ca	www.atitech.ca	www.total3d.com	www.creativelabs.com	www.diamondmm.com	www.diamondmm.com	www.diamondmm.com
Warranty	5 years	5 years	1 year	3 years	5 years	5 years	5 years

N/A—Not applicable: The product does not have this feature.

elsewhere, but budget-constrained home and business users may want to stop and consider.

Creature comforts on the Phantom 3D/DX are adequate. The board installed easily, and the ProPilot 95 control panel functioned well. One nice touch: The utility includes a technical-support information panel with a telephone number and Web address. Also included is a Xing MPEG player and the WIRL VRML 1.0 browser from Vream; both performed reasonably well.

On our 2-D tests, the Phantom 3D was a top performer, beating out much of the higher-priced competition. Its 3-D accel-

eration landed the Phantom in the middle of the pack, besting many of the more expensive ViRGE boards but trailing boards with state-of-the-art chip sets such as the Permedia NT and Rendition Verite V1000.

If you're hunting for a bargain board for 2-D and occasional 3-D, the Phantom 3D/DX should be near the top of your list. It delivers performance comparable or even superior to that of other, higher-priced ViRGE-based boards at a very attractive price.—*Rob Glidden*

Phantom 3D/DX. List price: \$135. Genoa Systems Corp., San Jose, CA; 408-362-2929; www.genoasys.com. *Circle 526 on reader service card.*

HERCULES COMPUTER TECHNOLOGY INC.

Terminator 3D/DX

Hercules' reasonably priced Terminator 3D/DX (\$169 list, \$150 street) provides strong 2-D performance, and its support for a range of operating systems makes it ideal for MIS departments serving multiple environments. But for 3-D gamers or anyone gearing up for the coming 3-D business applications, the Terminator's 3-D performance won't satisfy.

The ViRGE DX-based board includes drivers and documentation for Microsoft

Graphics Accelerators

Continues

ELSA Winner 2000AVI/3D	ELSA Winner 3000-M	Genoa Phantom 3D/DX
\$349.00, \$290	\$349.00, \$300	\$135.00, \$95
S3 ViRGE VX	S3 ViRGE VX	S3 ViRGE DX
4MB, 4MB EDO VRAM	4MB, 4MB VRAM, EDO DRAM	4MB, 4MB EDO DRAM
■	■	■
1,600 x 1,200	1,600 x 1,200	1,280 x 1,024
65,000, 16.7 mil	256, 256	256, 65,000
16.7 mil, 16.7 mil	65,000, 16.7 mil	16.7 mil, 16.7 mil
N/A	N/A	N/A
None	None	None
■ ■ ■	■ ■ ■	■ ■ ■
■ ■ ■	■ ■ ■	■ ■ ■
■ ■ ■	■ ■ ■	■ ■ ■
■ ■ ■	■ ■ ■	■ ■ ■
■ ■ ■	■ ■ ■	■ ■ ■
CompCore SoftPEG	CompCore SoftPEG	Xing MPEG Player
■ ■ ■	■ ■ ■	■ ■ ■
■ ■ ■	■ ■ ■	■ ■ ■
■ ■ ■	■ ■ ■	■ ■ ■
■ ■ ■	■ ■ ■	■ ■ ■
■ ■ ■	■ ■ ■	■ ■ ■
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3 years	3 years	2 years

Windows 95, Windows 3.1, Windows NT 3.51 and 4.0, and OS/2 Warp—one of the widest offerings among the products in this review. Hercules also bundles MPEG-1 and MPEG-2 players and Decent II: Destination Quatzon.

Setting up the Terminator was as simple as inserting the CD-ROM into the drive (though you have to install the MPEG-1 playback drivers separately). However, we found the Touch display utilities disjointed and poorly integrated with Windows 95's Display Properties dialog. For example, Touch provides refresh rate adjustment and a virtual desktop, but to change color depth on the fly you have to rely on Windows' Display Properties (and only if you are using Windows 95 OSR/2 or later). The board supports 65,000 colors at 1,280-by-1,024, which will satisfy most users.

Like most ViRGE DX boards, the Terminator performed extremely well on our 2-D ZD Business Winstone and ZD Business WinMark 97 tests. But the board is behind the curve on 3-D performance. Though image quality was generally crisp and clear, not all Direct3D modes (such as specular highlighting) are supported in hardware.

Though the Terminator 3D/DX is a solid choice for button-down department heads, 3-D enthusiasts are likely to be disappointed.—*JO*

Terminator 3D/DX. List price: \$169. Hercules Computer Technology Inc., Fremont, CA; 800-532-0500, 510-623-6030; www.hercules.com. Circle 527 on reader service card.

INTERGRAPH COMPUTER SYSTEMS Intense 3D 100

If your performance requirements reach beyond your budget, consider Intergraph Computer Systems' Intense 3D 100 (\$149 list, \$140 street).

Formerly known as the Reactor 3D, this board won Editors' Choice in our roundup seven months ago ("3-D for Free," December 3, 1996) for its good 2-D and unparalleled 3-D performance. While it's no longer the fastest 3-D board on the block, the Rendition Verite V1000-based Intense 3D still delivers a good mix of performance features for business users and casual gamers.

Setting up the board was trouble-free.

Large-screen and graphics users should note that the board's top resolution is 1,280-by-1,024, and that's only at a 60-Hz refresh rate. The Intense 3D's support for 1,024-by-768 resolution (in high-color mode) at 85 Hz should be sufficient for most mainstream users. It is complemented by a 135-MHz RAMDAC and 4MB of EDO RAM. The package includes some top-notch games, including a full version of IndyCar Racing II, a shareware version of Quake, and demo versions of Microsoft's Monster Truck Madness and Hellbender.

On 2-D and 3-D tests, Intergraph's board turned in high scores; it placed fourth on the 3D Graphics WinMark suite. More importantly, the card's image quality in 3-D scenes was better than that of most of its competitors. Support for fog and transparency modes was excellent.

Those looking for decent 3-D performance in a package costing about \$100 less than the leading boards in this review should definitely consider the Intense 3D 100. You won't be the fastest on the draw, but your pocketbook will thank you.—*JRQ*

Intense 3D 100. List price: \$149. Intergraph Computer Systems, Huntsville, AL; 800-692-8069, 205-730-5441; www.intergraph.com/ics/i3d100. Circle 528 on reader service card.

LEADTEK RESEARCH INC. WinFast 3D L2200

The WinFast 3D L2200 (\$319 list, \$300 street) is the only board we reviewed that uses 3Dlabs' new Permedia NT chip set. The board's outstanding 3-D performance will impress gamers and 3-D enthusiasts, and the WinFast 3D can even serve in an entry-level 3-D graphics platform. Business users looking for a mix of 3-D capability and solid 2-D performance, however, won't find the WinFast 3D a suitable choice.

The WinFast 3D is light on creature comforts. The installation was ad-

SUITABILITY TO TASK WinFast 3D L2200

2-D performance	Fair
3-D performance	Excellent
3-D visual quality	Excellent
Creature comforts	Poor



SUITABILITY TO TASK Terminator 3D/DX

2-D performance	Excellent
3-D performance	Poor
3-D visual quality	Good
Creature comforts	Good

SUMMARY OF FEATURES

2-D/3-D Graphics Accelerators

■ YES ■ NO □ OPTIONAL

Products listed in review order

	Hercules Terminator 3D/DX	Intergraph Intense 3D 100	Leadtek WinFast 3D L2200	Matrox Mystique 220	Number Nine 9FX Reality 772	Sierra On-Line Screamin' 3D	STB Nitro 3D
List/street price	\$169.00, \$150	\$149.00, \$140	\$319.00, \$300	\$199.00, \$180	\$279.00, \$260	\$199.00, \$200	\$149.00, \$150
Graphics accelerator chip	S3 ViRGE DX	Rendition V1000	3DLabs Permedia NT	MGA-1164SG	S3 ViRGE VX	Rendition V1000	S3 ViRGE GX
Tested/installable display memory	4MB, 4MB	4MB, 4MB	4MB, 4MB	4MB, 8MB	4MB, 4MB	4MB, 4MB	4MB, 4MB
Memory type	EDO DRAM	EDO DRAM	SGRAM	SGRAM	EDO VRAM	EDO DRAM	EDO DRAM
VGA pass-through connector	■	■	■	■	■	■	■
Maximum noninterlaced graphics resolution (dpi)	1,800 x 1,200	1,280 x 1,024	1,600 x 1,200	1,600 x 1,200	1,600 x 1,200	1,280 x 1,024	1,800 x 1,200
Maximum number of colors at:							
1,800 x 1,200; 1,280 x 1,024	256, 65,000	N/A, 256	256, 65,000	65,000, 16.7 mil.	65,000, 16.7 mil.	N/A, 256	256, 65,000
1,024 x 768; 800 x 600	16.7 mil., 16.7 mil.	65,500, 16.7 mil.	16.7 mil., 16.7 mil.	16.7 mil., 16.7 mil.	16.7 mil., 16.7 mil.	65,500, 16.7 mil.	16.7 mil., 16.7 mil.
List price for add-on TV tuner	N/A	N/A	N/A	\$79	N/A	N/A	\$129
Other add-on options	None	None	None	Video capture, TV-out, MPEG-2 decoder	None	None	None

Software and 3-D Features

Drivers for Windows 3.x/95/NT	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Drivers for OS/2, AutoCAD, MicroStation	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
User can reset resolution without rebooting	■	■	■	■	■	■	■
User can reset color depth without rebooting	■	■	■	■	■	■	■
Supports hardware zoom	■	■	■	■	■	■	■
Supports virtual display	■	■	■	■	■	■	■
MPEG playback utility	Xing MPEG Player	None	Microsoft ActiveMovie	CompCore SoftPEG	Microsoft ActiveMovie	Total Cinema	Mediamatics Arcade
Supports double buffering	■	■	■	■	■	■	■
Supports primitives/triangle strips	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Texture modes supported:							
Point sampling/Bilinear filtering	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Bilinear/trilinear MIP mapping	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Palletized textures/Texture compression	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Atmospheric effects supported:							
Fog/Transparency (alpha blending)	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Specular highlighting/Color-key transparency	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■

Customer Support

Toll-free technical support	■	■	■	■	■	■	■
Technical-support hours (eastern time)	9:00-9:00 M-F	6:00-6:00 M-F, 8:00-5:00 Sat.	9:00-6:00 M-F	8:00-7:00 M-F	7:00-6:00 M-F	11:00-8:00 M-F	9:00-7:00 M-F
Web address	www.hercules.com	www.intergraph.com/vics/3d100	www.leadtek.com	www.matrox.com/mga	www.nine.com	www.sierra.com	www.stb.com
Warranty	5 years	5 years	1 year	3 years	5 years	1 year	Lifetime

N/A—Not applicable: The product does not have this feature.

equate, but the driver lacked the display properties and user interface panels that we've come to expect. (A newer version of the Display Properties panel includes a broader range of user settings, but it was not part of our test package.) The Permedia NT chip set combines the consumer-oriented 2-D and 3-D Permedia chip with 3DLabs' high-end GLINT Delta chip (a dominant force in the emerging NT-level graphics workstation market), which performs many of the geometry setup tasks.

The combination works: The WinFast 3D aced all our 3-D tests and placed first in our 3D Graphics WinMark suite, scoring a full ten points higher than the sec-

ond-place Canopus Total 3D (based on the Rendition V1000). It left the ViRGE-, 3D Rage II-, and Cirrus Logic GD5464-based boards eating dirt. The WinFast 3D supports most of the major Direct3D features, but not MIP mapping—an oversight for a board with such 3-D aspirations. It's also the only board we tested that includes drivers for OpenGL and Heidi (Autodesk's graphics API).

Performance on our 2-D benchmark tests was a letdown. While the board will perform adequately for 2-D tasks, it isn't as speedy as most other current accelerator boards.

For 3-D-intensive use, the WinFast

3D is a winner. As a mainstream graphics board, its weak 2-D acceleration and lack of creature comforts mean that non-3-D buyers can do better elsewhere.—*RG*
WinFast 3D L2200. List price: \$319. Leadtek Research Inc., Fremont, CA; 510-490-8076; www.leadtek.com. *Circle 529 on reader service card.*

MATROX GRAPHICS INC.

Matrox Mystique 220

The Matrox Mystique 220 (\$199 list, \$180 street) from Matrox Graphics delivers top 2-D business graphics with eye-pleasing resolution and refresh rates. However,

Ends

TechWorks Ultimate 30	VideoLogic GrafixStar 550	VideoLogic GrafixStar 750
\$129.95, \$100	\$99.00, \$100	\$299.00, \$200
Cirrus Logic GD5464	Cirrus Logic GD5464	S3 ViRGE VX
4MB, 8MB	4MB, 4MB	4MB, 8MB
RAMBUS DRAM	RAMBUS	VRAM
1,600 x 1,200	1,600 x 1,200	1,800 x 1,400
256, 65,000	256, 65,000	65,000, 16.7 mil
16.7 mil, 16.7 mil	16.7 mil, 16.7 mil	16.7 mil, 16.7 mil
N/A	N/A	N/A
None	None	None
		
CompCore SoftPeg	Xing MPEG Player	Xing MPEG Player
		
		
8:00-8:00 M-F	11:30-7:30 M-F	11:30-7:30 M-F
www.techworks.com	www.videologic.com	www.videologic.com
3 years	5 years	5 years

its lack of hardware support for many key Direct3D rendering features puts a considerable drag on 3-D performance in many of our 3D Graphics WinMark scenes.

The bus logic in the Matrox chip supports full scatter/gather PCI bus mastering, a technique that speeds the loading of graphics data, such as textures or bitmaps, from memory into the frame

SUITABILITY TO TASK	
Matrox Mystique 220	
2-D performance	Excellent
3-D performance	Good
3-D visual quality	Poor
Creature comforts	Excellent

buffer. It includes a 220-MHz RAM-DAC, speed sufficient to support a maximum resolution of 1,600-by-1,200 with 65,000

colors at an 80-Hz refresh rate.

MGA PowerDesk, the **Mystique 220's** excellent control software, lets you fine-tune gamma and color temperature. It also lets you use the board's memory to virtually enlarge the desktop horizontally, vertically, or both.

The Mystique 220 earned one of the highest scores in our 2-D ZD Business Winstone 97 suite, thanks in large part to the board's 10-nanosecond SGRAM and the 93.6-MHz clock speed of the MGA-1164SG controller on the unit we received for testing. Most other boards in this price range use less-expensive memory and run at 60 to 80 MHz.

The Mystique 220 placed in the middle of the field on our 3D Graphics WinMark tests, ahead of the ViRGE-based boards but trailing the boards based on ATI, Rendition, and 3Dlabs chips.

The board lacks support for several popular Direct3D features such as bilinear filtering, fog, transparency, MIP mapping, and specular highlighting.

The Mystique 220 provides connectors for attaching the company's Rainbow Runner video-capture and editing board (Rainbow Runner Studio, \$279) and TV tuner (\$79). If 3-D acceleration isn't your top priority, the Mystique 220's fine 2-D performance and add-on options make it a good choice. If you want the added dimension of a forward-looking 3D board, however, you'll want to look elsewhere.—*Winn L. Rosch*

Matrox Mystique 220. List price: \$199. Matrox Graphics Inc., Dorval, Quebec, Canada; 800-844-8302; 514-969-6300; www.matrox.com/mga. *Circle 530 on reader service card.*

**NUMBER NINE
VISUAL TECHNOLOGY
9FX Reality 772**

Control freaks will find instant appeal in the HawkEye software bundled with Number Nine's 9FX Reality 772 (\$279 list, \$260 street); business users will appreciate the high refresh rates and fine 2-D performance it delivers; but 3-D enthusiasts may not be so impressed. Still, if it's a top-flight board you need for business, graphics, and occasional gaming, the Reality belongs on your short list.

The ViRGE VX-based Reality 772 demonstrated no bad habits on either 2-D business graphics or 3-D renderings, and it delivers resolutions as high as 1,600-by-1,200 at an 85-Hz refresh rate. We found its hardware design and construction flawless. The Reality uses EDO VRAM, which hikes the price considerably.

The Reality's HawkEye support software is unmatched. The program installed the board without a hitch, and it includes features not found anywhere else. For example, large-screen users will love the Chameleon Cursor, which can enlarge and tint the Windows cursor for better visibility. The Color Perfect feature lets you tweak monitor gamma.

On our 2-D ZD Business Graphics Winstone 97 suite, the Reality placed among the best of the boards we reviewed. Its 3-D performance was less impressive, putting it near the bottom of the pack on our 3D Graphics WinMark suite, its score brought down by the lack of hardware support for specular highlighting.

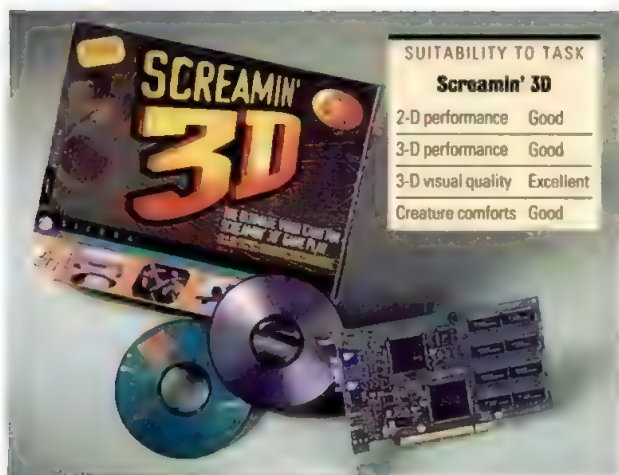
Essentially trouble- and worry-free, the 9FX Reality 772 is a likable graphics board with a terrific control utility, good 2-D, and fair 3-D speed. Other boards will give you stronger 3-D performance, but the HawkEye utilities and resolution support may swing the pendulum in favor of the Reality.—WLR

9FX Reality 772. List price: \$279. Number Nine Visual Technology, Lexington, MA; 800-438-6463, 617-674-0009; www.nine.com. *Circle 531 on reader service card.*

SIERRA ON-LINE
Screamin' 30

If you're a 3-D game enthusiast, Sierra On-Line wants your attention. The PC game developer has teamed up with Canopus (who designed the board) to deliver the Screamin' 3D (\$199 list and street), a Rendition V1000 board that yields excellent 3-D and solid 2-D performance. Though this board may not be the best choice for business users, serious gamers will want to take a look.

Screamin' 3D includes an excellent



gamer-friendly install program, Graphic Toolkit, which checks to see whether your system meets the requirements to run the included game bundle. The package includes such games as CyberGladiators, Silent Thunder, and IndyCar Racing II. Potential users should note that the board can support resolutions only up to 1,280-by-1,024 (most of the boards in this review support 1,600-by-1,200), and that only at a 256-color depth. If you need true-color mode (16.7 million colors), you have to drop back to 800-by-600 resolution.

The board's performance on our 3D Graphics WinMark tests was excellent. The Screamin' 3D placed third, behind the more expensive Leadtek WinFast 3D (based on the Permedia NT chip set) and Canopus's Total 3D Graphics (also based on the Rendition V1000). Performance on our 2-D tests was fine, and the board did well on our ZD Business Winstone 97 suite.

As a 3D game board, the Screamin' 3D offers strong performance and a good game bundle at a reasonable price.—*RG*
Screamin' 3D. List price: \$199. Sierra On-Line, Bellevue, WA; 800-757-7707, 206-649-9800; www.sierra.com. *Circle 532 on reader service card.*

STB SYSTEMS INC.

Nitro 3D

STB Systems' Nitro 3D (\$149 list and street) is an affordable, top-tier 2-D accelerator with good (though not spectacular) 3-D performance. The Nitro, based on S3's latest ViRGE iteration, the GX, is a fine choice for corporate and home users who put work first and fun second.

The board includes 4MB of EDO DRAM and supports a 1,600-by-1,200 resolution with 256 colors. STB's Vision 95 excellent display management tools include features that let you zoom, set the desktop larger than the screen, and even create a window that displays a long-distance view of the screen.

The Nitro also bundles a handsome set of software: the games HyperBlade, Spycraft, Interstate '76, and MechWarrior 2; a limited version of Simply 3D from Micrografx; and a copy of Vream's WIRL VRML browser.

The Nitro was a top performer on our ZD Business Winstone 97 and ZD Busi-

The Nitro 3D's display management tools make it a fine choice for users who put work first.

ness Graphics WinMark 97 2-D tests. On our 3D Graphics WinMark test suite, the Nitro beat the other ViRGE-based boards (thanks to its newer GX chip), but its lack of feature support forced it to run several tests in software mode, which slowed down performance. The board doesn't support transparency, specular lighting, and MIP mapping, though the documentation states otherwise.

If the best 3-D performance is tops on your list, a competing board is a better choice. But if you're looking for a full-function, general purpose graphics board at a reasonable price, the Nitro will serve you well.—*RG*

Nitro 3D. List price: \$149. STB Systems Inc., Richardson, TX; 888-234-8750, 972-234-8750; www.stb.com. *Circle 533 on reader service card.*

TECHWORKS INC.

Ultimate 3D

The Ultimate 3D (\$129 list, \$100 street) from graphics-card newcomer TechWorks claims to blow the doors off other 3-D graphics accelerator cards in the same price and performance range. Indeed, TechWorks uses its price-savvy experience from the memory upgrade market to deliver bargain prices; unfortunately the Ultimate 3D's Cirrus Logic chip can't deliver on the performance half of the promise.

The Ultimate 3D has the feel of a rushed-to-market board. Rough edges include an electronic user's manual in Adobe Acrobat .PDF format, but no Adobe viewer is supplied to read the document. There is no MPEG viewer, and the CD includes the entire DirectX software developer's kit instead of just the drivers necessary to run the board. And there are minimal user-interface creature comforts. The board ships with 4MB of RAMBUS DRAM and supports a maximum resolution of 1,600-by-1,200 with 256 colors.

Based on Cirrus Logic's GD5464 graphics chip, Ultimate 3D did place in the middle of the pack on our 3D Graphics WinMark suite, ahead of all the ViRGE-based products. But the board's 3-D support simply isn't ready for prime time. Texture maps appeared smeared, some triangles displayed the wrong texture, and the transparency feature worked only intermittently. TechWorks claims such problems will be resolved by future drivers. To the board's credit, performance on our 2-D test suite was more than adequate, and it did well in our ZD Business Winstone 97 test suite.

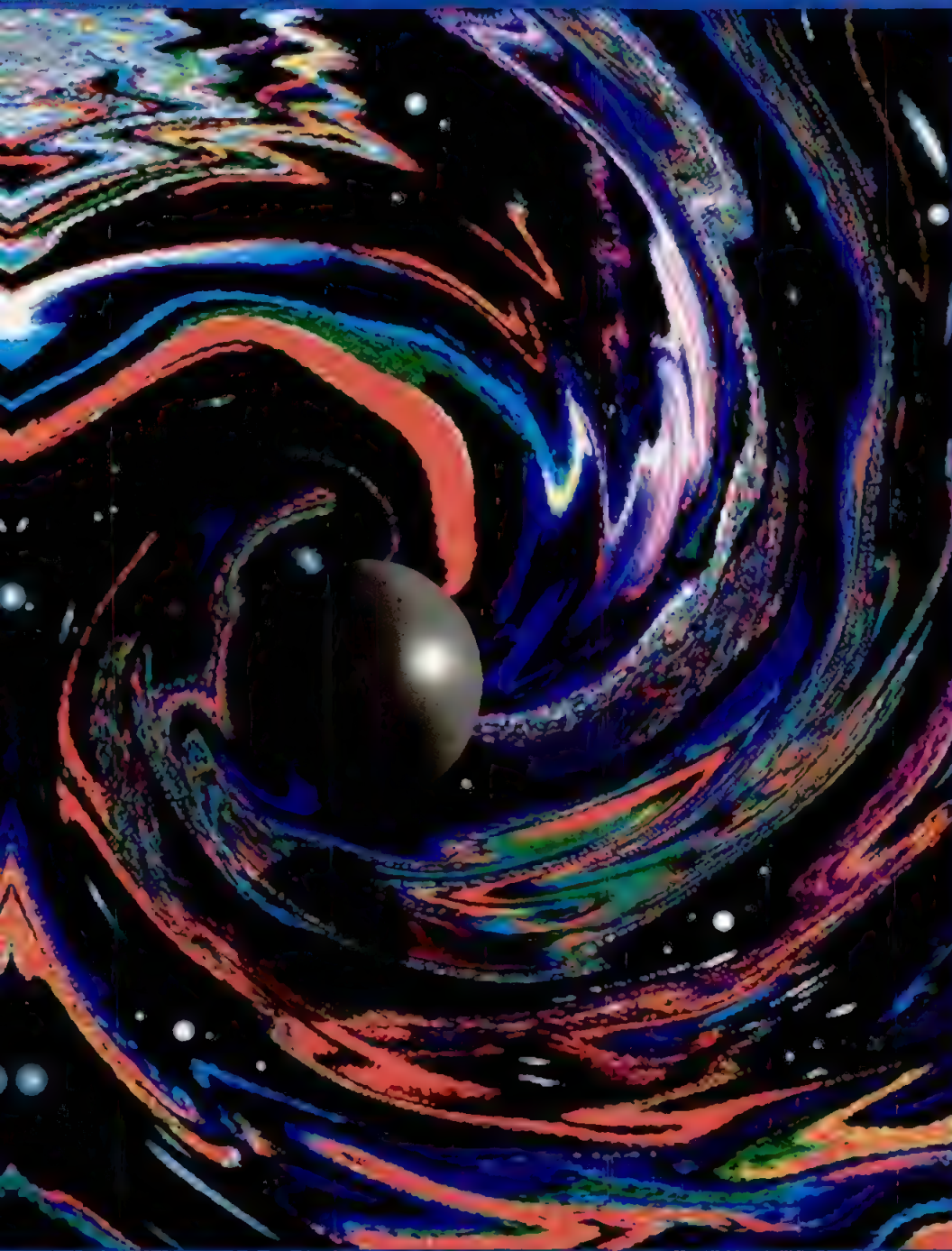
Bargain hunters may be tempted by Ultimate 3D's low price. There's even a 2MB version for just \$80 and an 8MB version for \$180. But spotty 3-D support and rough edges make this a bargain worth passing up.—*RG*

Ultimate 3D. List price: \$129. Tech Works Inc., Austin, TX; 800-688-7466, 512-794-8533; www.techworks.com. *Circle 534 on reader service card.*

SUITABILITY TO TASK	
Ultimate 3D	
2-D performance	Good
3-D performance	Fair
3-D visual quality	Poor
Creature comforts	Fair

SUITABILITY TO TASK	
Nitro 3D	
2-D performance	Excellent
3-D performance	Fair
3-D visual quality	Fair
Creature comforts	Excellent

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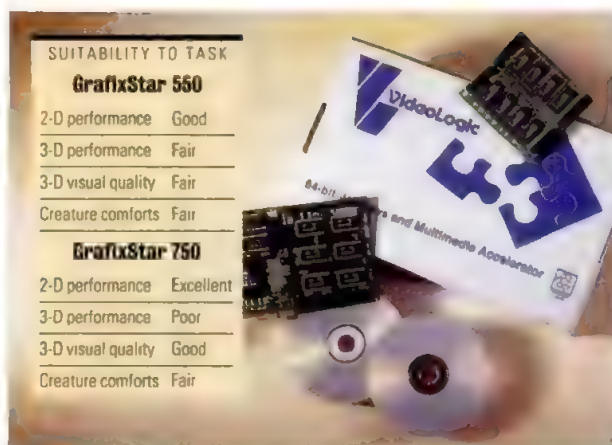
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HARDWARE

Graphics Accelerators



SUITABILITY TO TASK

GrafixStar 550

2-D performance	Good
3-D performance	Fair
3-D visual quality	Fair
Creature comforts	Fair

GrafixStar 750

2-D performance	Excellent
3-D performance	Poor
3-D visual quality	Good
Creature comforts	Fair

VIDEOLOGIC INC.

GrafixStar 550, GrafixStar 750

Videologic has long been an industry innovator, but neither the GrafixStar 550 nor the GrafixStar 750 stands out compared with similarly equipped cards. The GrafixStar 550 (\$99 list and street) is adequate for mainstream users on a budget who are willing to trade off 2-D performance for a low price; image anomalies in 3-D make it tough to recommend for serious use there.

The appeal of the GrafixStar 750 (\$299 list, \$200 street) lies chiefly in its good 2-D performance, ultra-high resolution support, and optional 4MB of texture memory to enhance 3-D performance.

Aimed at business and home users on a budget, the GrafixStar 550 is a generic card based on the Cirrus Logic GD5464 chip. The SmartTools driver utilities are limited but adequate; they include SmartDesktop for managing your virtual desktop and a SmartDisplay wizard to help simplify setup.

While the GrafixStar 550 outperformed its ViRGE VX-based sibling on our 3D Graphics WinMark tests, its score of 33.5 placed it in the middle of the pack. It also suffered from display anomalies—on some tests, the entire screen was displaced to the right by a few inches. The board doesn't support fog or specular highlighting, and color-keyed transparency worked only sporadically.

The GrafixStar 550 was significantly slower than the fastest board on our 3D Graphics WinMark test and was one of

the few products that degraded overall system performance. Winstone results indicated that a system using the GrafixStar 550 would run roughly 5 percent slower than one with the GrafixStar 750 on general business applications.

The GrafixStar 750 supports resolutions up to 1,800-by-1,440 (the 550 tops out at 1,600-by-

1,200) and provides vertical refresh rates as high as 80 Hz at 1,600-by-1,200 resolution, so the board is a reasonable choice for graphics design and CAD work (AutoCAD drivers are available for both products).

Installing the GrafixStar 750 required an extra step: Since our Windows 95 test-bed identified the GrafixStar 750 as a generic S3 ViRGE card, we had to install VideoLogic's ViRGE VX drivers manually.

The GrafixStar 750 delivered much better 2-D performance results than the 550 in the ZD Business Winstone 97 tests, and came in second on the ZD Business Graphics WinMark tests (behind the Genoa Phantom 3D/DX). Like the other ViRGE VX-based products we tested, the GrafixStar 750 was disappointing in its 3-D performance. It placed in the bottom third of the 3D Graphics WinMark rankings. VideoLogic offers a 4MB DRAM module (\$50 street) to speed texture processing—a near-necessity if you plan to use the GrafixStar 750 for serious 3-D work.

Both boards come with ProLab's image editing suite, which includes ImageFolio, an image-editing package; VideoWork for video editing and capture; and MediaScope, a CD player.

Not as polished as offerings from top competitors, both products might be reasonable alternatives if you can find them at a good price—but neither is particularly compelling.—JH □

GrafixStar 550. List price: \$99. **GrafixStar 750.** List price: \$299. Videologic Inc., San Bruno, CA; 800-578-5644, 415-875-0606; www.videologic.com. Circle 535 on reader service card.

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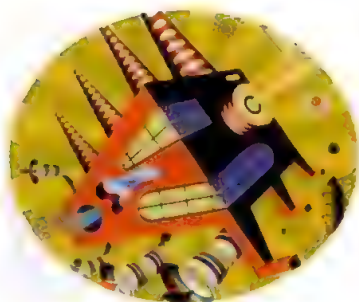
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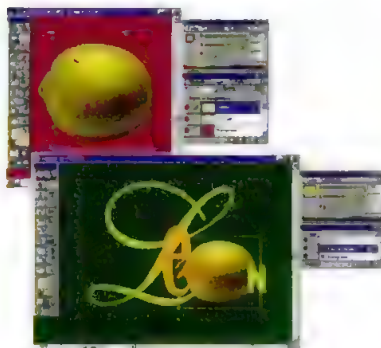
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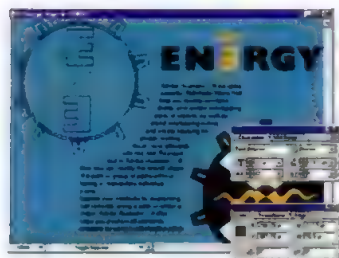
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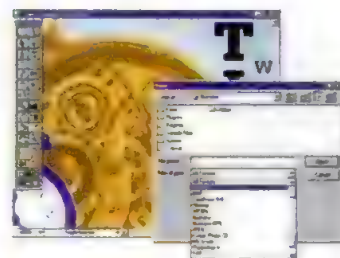
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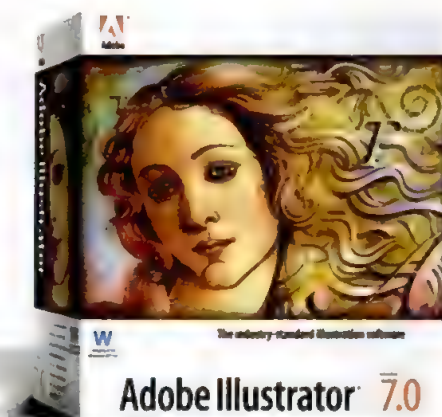
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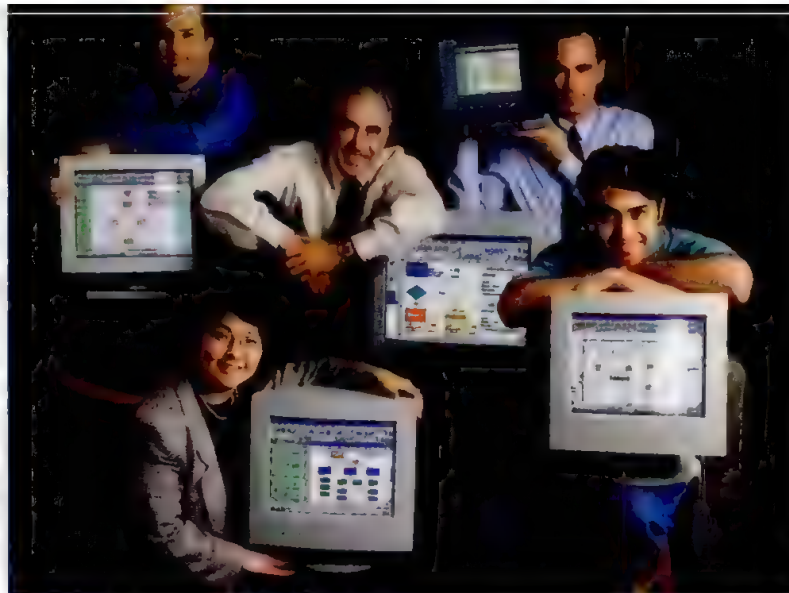
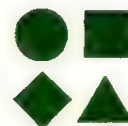
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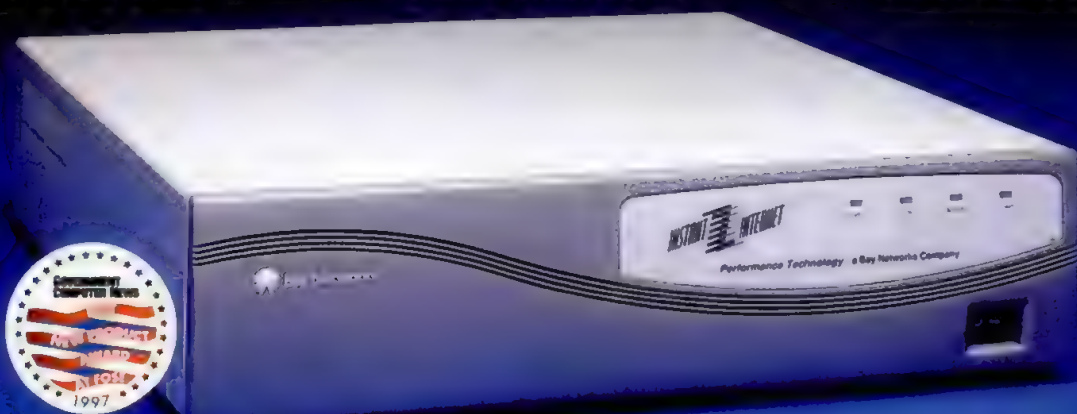


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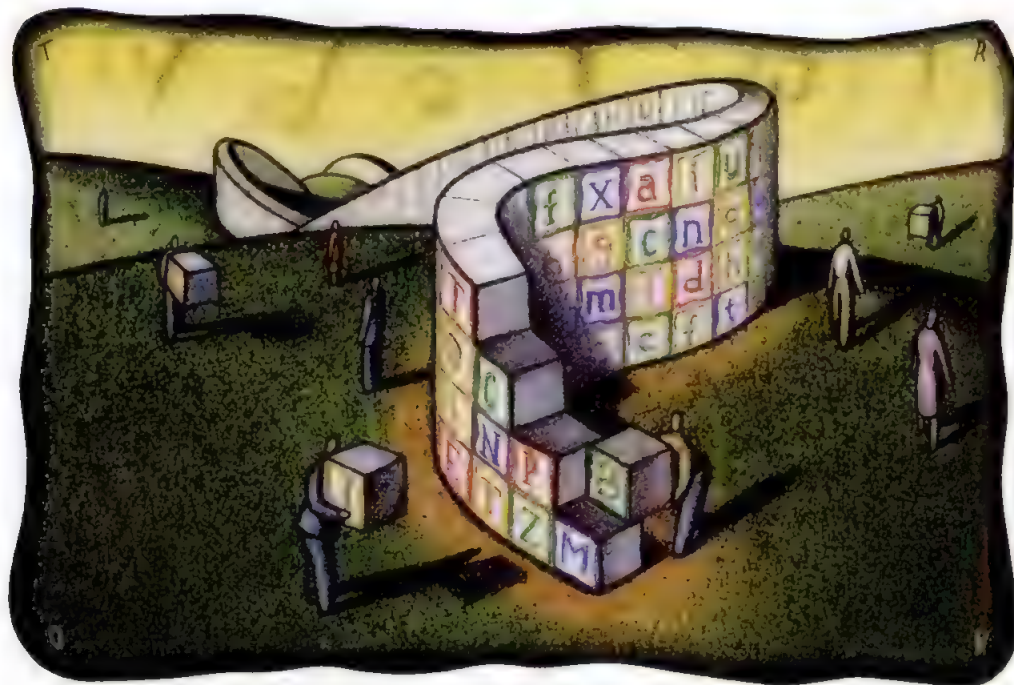
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Spotlight on JavaScript

One language or two? As usual, Microsoft and Netscape offer differing versions of an open standard.

By William Robert Stanek

Web technologies are changing at a phenomenal rate, and every time a new technology is introduced you can almost guarantee that within six months someone will extend it, enhance it, or otherwise alter forever the way it works. Nowhere is this more evident than with Web programming, and with JavaScript in particular. In the previous issue we examined JavaScript (along with VBScript) as we explored Web scripting languages. Here we'll look again at JavaScript, focusing on two implementations: Netscape's JavaScript and Microsoft's JScript.

JavaScript was introduced to the world as LiveScript and before anyone could punt, Netscape changed the name and the language's fundamentals. JavaScript is already in its third revision, and although every revision has taken the scripting language a step further in functionality, the constant changes can be frustrating for Web developers who want to create pages that

work in the broadest spectrum of browsers. After all, what good is an awesome JavaScript-powered page that cannot be accessed by millions of the site's visitors?

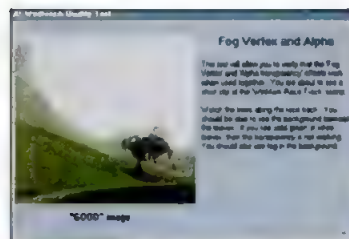
As if rapid change were not difficult enough, Microsoft implemented its own variation of JavaScript, called JScript, currently in its second major revision. Just as Netscape's JavaScript is designed to be used with Netscape Navigator, JScript is designed to be used with Internet Explorer. Although the two implementations are similar, each includes some unique features. And the fundamental differences between the two mean that your wonderful JavaScript-powered Web page may not work in the "other" browser, eliminating perhaps millions of potential visitors. So, as a Web publisher, what do you do? Do you adopt one scripting model over the other? Or do you try to create scripts that will work with both JavaScript and JScript?

To help you answer these questions, we will take a closer look at both languages, followed by

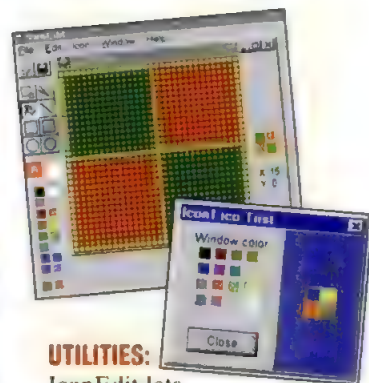
INSIDE

POWER PROGRAMMING:

Two ways to transfer data across process boundaries in Windows NT. *Page 235.*



LAB NOTES: To address the importance of 3-D applications and accelerators, PC Labs now introduces 3D WinBench 97, which uses the Direct3D API. *Page 243.*



UTILITIES:

IconEdit lets you design and assign custom desktop icons for programs running under Windows 95 and rescales them as needed. *Page 247.*

SOLUTIONS: Why your new IDE hard disk has replaced your old SCSI disk as the boot drive; getting Excel to represent elapsed time; and more. *Page 285.*

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a head-to-head comparison, including specific pointers on how to create scripts that will work in both Netscape Navigator and Internet Explorer.

NETSCAPE'S JAVASCRIPT

Sure, JavaScript is great for transforming lifeless Web pages into dynamic, fully interactive pages with real-time response. But what if you want something more? What if you want to move beyond the traditional boundaries of Web scripting? What if, for example, you want to use JavaScript to perform both client-side and server-side tasks? Can JavaScript meet the challenge?

The answer is a resounding yes. JavaScript has evolved from a quick fix for client-side scripting to a comprehensive framework for meeting both client-side and server-side development needs. The client-side framework that you rely on when working with Web pages is

implemented in the Netscape Navigator browser. When you work with back-end processing, you rely on server-side JavaScript. The server-side framework is an extension for Netscape servers implemented in a product called LiveWire. Within Netscape FastTrack or Enterprise servers, LiveWire and JavaScript end the need for gateway scripts and form a comprehensive server-side solution for file manipulation, database management, and more.

Right now you may be saying to yourself, wait a minute, I thought JavaScript was an open standard that wouldn't tie me to a specific company or product. That was the idea, but things haven't exactly turned out that way. Ultimately, you are tied to specific Netscape products and technologies when you work with JavaScript. Still, there is an upside to the tight integration of JavaScript into Netscape's technology model, especially when it comes to Netscape ONE (Open Networked Environment).

Netscape ONE is designed to be a cross-platform development environment that includes many different technologies for creating Web-based applications. A key component of this environment is LiveConnect, a framework for connecting technologies such as Java, JavaScript, and plug-ins. With it you can create scripts that update Java applets, Netscape plug-ins that interact with Java applets, and Java applets that call script functions. Although LiveConnect is a powerful innovation, it's not really a separate technology but rather an extension framework for existing technologies such as JavaScript. Thus you use the LiveConnect extensions for JavaScript to create scripts that interact with Java applets and Netscape plug-ins.

MICROSOFT'S JSCRIPT

Microsoft recognized the potential of JavaScript almost immediately, and implemented its own version, Jscript, in the process changing some of the scripting language's fundamentals. But JScript is also a comprehensive solution for Web development. Just as JavaScript is tightly integrated into Netscape's technology model, JScript is tightly integrated into Microsoft's model. It is designed to be a

full implementation of JavaScript with specific enhancements for the Internet Explorer browser. Because of this, the JScript and JavaScript object frameworks are similar, and you can use JScript in Web pages just as you use JavaScript.

Beyond the similarity of their object frameworks, JScript and JavaScript are strikingly different in the way their object models are created and implemented. JScript's core language functionality and baseline object framework are defined in the JScript specification, extended with the Internet Explorer's object model for scripting. It is within this enhanced object

model that JScript obtains most of its functionality. Contrast the separation of core functionality and the browser object model with Netscape's integrated model, where the core functionality is tightly woven into the object framework and you may conclude that Microsoft chose a path for implementing Jscript that was not only different but better.

The separation of the Internet Explorer object model from the JScript object model allows Microsoft to do some pretty amazing things, one of which is to make the Internet Explorer object model accessible to any other scripting language (such as VBScript) implemented in the browser. This enables Microsoft to extend the functionality of both JScript and VBScript by updating Internet Explorer's object model. This same object model is also part of Microsoft's ActiveX framework.

ActiveX, like LiveConnect, is a framework for connecting technologies. Unlike LiveConnect, ActiveX uses an enhanced object linking and embedding (OLE) interface to connect ActiveX controls, scripts, and Java applets. While OLE is certainly not a new technology, applying OLE to the Internet is a groundbreaking innovation that, along with JScript, lets you create Web pages with features such as virtual reality, 360-degree control over video, real-time audio, and even video games.

Behind the scenes, JScript provides the interfaces and hooks that allow all the elements to connect together. The widespread popularity of ActiveX gives JScript a home court advantage over JavaScript. After all, if you want

FUNCTIONS AND CONTROL FLOW

	✓ YES	✗ NO	JScript	JavaScript
Built-In Functions				
eval()	✓		✓	✓
escape()/unescape()	✓		✓	✓
isNaN()	✓		✓	✗
parseFloat()/parseInt()	✓		✓	✓
taint()/untaint()	✗		✗	✓
Control Flow				
for looping	✓		✓	✓
for each/in looping	✓		✓	✓
if ... then ... else	✓		✓	✓
select/switch case	✗		✗	✓
while looping	✓		✓	✓
do while looping	✗		✗	✓
break/exit function	✓		✓	✓
goto (labels)	✗		✗	✓

FIGURE 2: The availability of built-in functions and control-flow mechanisms in JavaScript and JScript.

OPERATORS

Arithmetic

+	Plus
-	Minus
*	Multiply
/	Divide
++	Increment
--	Decrement
-	Negate
%	Modulo

Assignment

=	Equals
+=	Add by value
-=	Subtract by value
*=	Multiply by value
/=	Divide by value
%=	Modulo by value
&=	Bitwise AND by value
=	Bitwise OR by value

Bitwise

&	Bitwise AND
	Bitwise OR
^	Bitwise XOR
~	Bitwise NOT
<<	Shift Left
>>	Shift Right
>>>	Zero Fill

Comparison

=	Object Equality
!=	Does not equal
>	Greater than
>=	Greater than or equal
<	Less than
<=	Less than or equal

Logical

&&	AND
	OR
!	NOT

FIGURE 1: These operators are available in both JavaScript and JScript.

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your scripts to be able to take advantage of everything ActiveX has to offer, you will need to use JScript. This remains true even with Navigator 4.0's limited ActiveX support.

On the server side, the object model for JScript is defined in the Active server framework, available in any of Microsoft's Active servers including the Internet Information Server Versions 3.0 and later.

JAVASCRIPT VS. JSCRIPT

The versatile and dynamic nature of both JavaScript and JScript derives from their strong ties to their respective frameworks. Thus JavaScript is ideal if you're using Netscape clients and servers, and JScript is the obvious choice for those using Microsoft clients and servers.

On a corporate intranet you can choose

which clients and servers to support. On the Web you don't have the luxury of deciding who will visit your site. For this reason, familiarity with the strengths and weaknesses of both scripting languages can help you determine when to use one or the other.

When you examine core functionality, you will find that JavaScript and JScript are quite similar, especially when you look at their syn-

OBJECT SUPPORT IN JSCRIPT AND JAVASCRIPT

✓ YES X NO

Object	JScript support	JScript core object set*	JavaScript support	Same properties and methods	JScript omits type but adds form reference	Description
anchor	✓		✓	✓		Used with named anchors in a Web page. Both JScript and JavaScript support a single property called <i>name</i> .
applet	X		✓			Used with Java applets added to the page with the <APPLET> tag. Although JScript does not support this object, it does support embedded objects with the <OBJECT> tag.
area	X		✓			Used with client-side image maps. Although JScript does not support this object now, it does support a way to obtain pixel locations and mouse clicks over linked objects.
Array	✓	✓	✓	✓		Used with arrays.
button	✓		✓	X	✓	Used with push buttons.**
checkbox	✓		✓	X		Used with check boxes.**
Date	X	✓	✓	✓		Used to manipulate dates and times.
document	✓		✓	✓		Used to access information and objects related to a document. JScript does not allow you to access images, applets, or objects embedded with the <EMBED> tag, nor does it support JavaScript style sheets (tags, classes, and id).
event	X		✓			Used with event handlers; new in JavaScript 1.2.
fileUpload	X		✓			Used with file-upload fields.**
form	✓		✓	X		Used with forms in Web pages. Although JScript does not support the <i>reset()</i> method or the <i>onReset</i> event, it does support embedded objects with the <OBJECT> tag via the <i>form</i> object. JavaScript does not currently support the <OBJECT> tag.
frame	✓		✓	X		Used with frame-enhanced Web pages. JScript does not support <i>onerror</i> , <i>focus()</i> , <i>blur()</i> , <i>scroll()</i> , <i>onBlur</i> , or <i>onFocus</i> . JavaScript does not support the <i>navigate()</i> method.
function	✓		✓	✓		Used to access properties of functions.
hidden	✓		✓	X	✓	Used with hidden elements.**
history	✓		✓	X		Used to access a browser's history list. Because JScript does not allow data tainting, the <i>current</i> , <i>next</i> , and <i>previous</i> properties are not supported.
image	X		✓			Used to manipulate images in Web pages.
layer	X		✓			Used with 2-D layouts; new in JavaScript 1.2.
link	✓		✓	X		Used to manipulate hypertext links in Web pages. JavaScript does not support the <i>onMouseMove</i> event used to obtain pixel location and mouse clicks over linked objects. JScript does not support the <i>onMouseOut</i> event.
location	✓		✓	X		Used to access information pertaining to the full URL of the document in the referenced window. Although JScript does not support the <i>reload()</i> and <i>replace()</i> methods, you can use the <i>navigate()</i> method of the window and frame object to load documents.
Math	X	✓	✓	✓		Used to perform common math functions.
navigator	✓		✓	X		Used to access information about the user's browser. JScript does not support <i>javaEnabled()</i> , <i>taintEnabled()</i> , <i>mimeTypes()</i> , or <i>plugins()</i> .
mimeType	X		✓			Used to access information about the MIME types a browser supports.
password	✓		✓	X	✓	Used with password fields.**
plugin	X		✓			Used to access information about the plug-ins configured for a browser.
radio	✓		✓	X	✓	Used with radio buttons.**
reset	✓		✓	X	✓	Used with reset buttons.**
select	✓		✓	X		Used with selection menus.** JScript does not support the <i>type</i> property. JavaScript does not support <i>form</i> , <i>options.name()</i> , or <i>options.length()</i> .
String	X	✓	✓	✓		Used to manipulate strings.
submit	✓		✓	X	✓	Used with submit buttons.**
text	✓		✓	X		Used with text-input fields.** JScript does not support the <i>type</i> property. JavaScript does not support the <i>form</i> property.
textarea	✓		✓	X	✓	Used with text-area fields.**
window	✓		✓	X		Used to work with or create a browser window. JavaScript does not support the <i>navigate()</i> method. JScript does not support <i>blur()</i> , <i>clearInterval()</i> , <i>focus()</i> , <i>moveBy()</i> , <i>moveTo()</i> , <i>resizeBy()</i> , <i>resizeTo()</i> , <i>scroll()</i> , <i>scrollBy()</i> , <i>scrollTo()</i> , <i>setInterval()</i> , or <i>onBl</i> .

* All objects supported by JScript but not checked in this column are part of the Internet Explorer object model, which is part of the Active scripting framework.

** Items found in forms.

FIGURE 3: Both JavaScript and JScript are object-based, but each supports a slightly different object set.



So it wasn't a surprise that an EIZO monitor — which, by the way, is pronounced A-ZO — was picked as a *PC Magazine's* Editors' Choice in 1996, that is, the FlexScan® TX-C75 which boasts a showy 0.25mm pitch Trinitron® aperture grille tube firing up a high refresh rate of 1280 x 1024 pixels of your latest efforts across every square millimeter of the beaming flat square surface of this eye-pleasing TCO 95 as well as ISO 9241-3 certified beauty, while equipping you with edgy performance ideas like Dynamic Focus Circuitry delivering razor sharp focus and cracker crisp corner to corner resolution, not to mention the conveniently built-in DDC circuitry that's so completely compatible with Windows 95 Plug & Play and Windows NT 4.0, and which is not meant to slight the remarkably cost-conscious and conservation-minded PowerManager™ feature or the consistency-enhancing Distortion Elimination Circuit that, obviously, has something to do with eliminating distortion which it does and which is no distortion at all but rather a complete and total statement of fact that helps EIZO win over 65 major performance awards in such a highly competitive marketplace.

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tax and operator set. The operators available in both are summarized in Figure 1. If you know a bit about Java or C/C++, most of the operators in the table should be very familiar.

Figure 2 shows the availability of built-in functions and control flows in JavaScript and JScript. JavaScript gains an edge over JScript in this area because of the introduction of a new version of JavaScript in Navigator 4.0 that adds control flows such as select/switch case, do-while looping and keyword labels.

The *Built-In Functions* section examines the core functions supported by JavaScript and JScript. These functions are used to perform common operations such as evaluating expressions, URL-encoding strings, and converting strings to numeric values. As you can

see, only JavaScript supports functions for data tainting. With data tainting enabled, you can overcome the security restrictions that limit the ways your scripts can access a browser's history list. These lowered restrictions allow your scripts to extract the actual URLs in the history list, which could give someone a list of every Web site a user has visited.

Data tainting also allows scripts to extract information from documents in different domains. Thus a script running in a framed document on your domain could access links, images, and objects in a document from a different domain that is loaded in another frame. Because data tainting is a security concern, it is designed

to be used on intranets or secure environments and can only be accessed when the programmer sets a specific environment variable.

Control Flow looks at the ways you can manage program flow within your script. In this area, JavaScript has an apparent advantage over JScript. Keep in mind, however, that case-switch and do-while structures can be implemented using the fundamental controls supported by JScript.

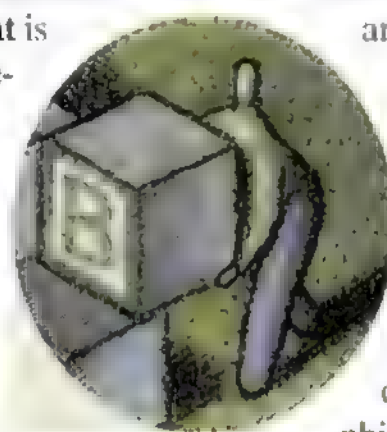
OBJECT SUPPORT

Both JavaScript and JScript are object-based, and you can learn a great deal about them by examining their object models. Although these object models were originally designed to be compatible, the two languages have evolved in different directions. As a result, each supports a slightly different object set, as Figure 3 makes evident. The table describes and compares the supported objects and also indicates when objects supported by both JScript and JavaScript have different features. As you examine this table, keep in mind that it describes the object set found in JavaScript 1.2 and JScript 2.0. Figure 3 provides a clear picture of the similarities and differences between the two object models, and can serve as a handy guide when you set out to create scripts for both Internet Explorer and Netscape Navigator.

CREATING CROSS-BROWSER SCRIPTS

More than 60 million people currently access the Web, and of these millions, 30 to 35 percent use Internet Explorer while 55 to 60 percent use Netscape Navigator. Because these two browsers dominate the market, your goal is to create scripts that run in both. The secret to doing so is to exploit the common ground between the JScript and JavaScript object models. This may seem like simple common sense. However, very few Web publishers truly understand the differences between JScript and JavaScript, and even fewer have ever plotted out exactly how JScript and JavaScript relate to each other. Now, armed with the information in Figures 2 and 3, you can begin creating scripts that will run in both Internet Explorer and Netscape Navigator.

As you develop scripts, keep in mind that the JScript and JavaScript specifications are fluid. With each new edition of Internet Explorer or Netscape Navigator, the corresponding language implementation will probably gain new functionality. If you want to use a particular feature exclusive to one, you should create your script so that it either informs users that the script uses a feature not supported by their browser, or that it runs in



```
<SCRIPT LANGUAGE="JavaScript">
<!--

//initialize variables
browserName = ""
browserName = navigator.appName

function shield() {

if (browserName == "Microsoft Internet Explorer") {
    ieCall()
}
else if (browserName == "Netscape") {
    nsCall()
}
else genCall()
}

function ieCall() {

//insert Internet Explorer and JScript-specific statements
//or Internet Explorer and JScript-specific function calls

}

function nsCall() {

//insert Netscape Navigator and JavaScript-specific statements
//or Netscape Navigator and JavaScript-specific function calls

}
function genCall() {

//a contingency function in case other browsers start to support JavaScript.
//You could insert generic statements or calls to generic functions.

}

// -->
</SCRIPT>
```



FIGURE 4: A script for cross-browser support.

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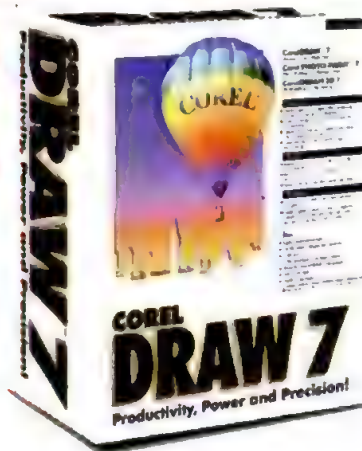
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Windows Sources, January 1997

Draw 7 will be an excellent choice for any Web page designer. . . . Draw 7 represents a real leap forward. . . . Draw users will cheer. But I think the real story about Draw 7 is its accessibility to new users. If you've never used an illustration app before, Draw 7 makes it easy.

*Government Computer News,
November 1996*

Graphics professionals, take note: if you have the power, Corel has the program. CorelDRAW 7 is a feature-packed behemoth with something to please professional illustrators, graphic artists, and desktop publishers alike.

C/Net.com, November 11, 1996

CorelDRAW 7 is the most stable and well-developed version of the program yet. Corel has taken the strongest elements from previous versions—CorelDRAW, Corel PHOTO-PAINT, and CorelDREAM 3D—and made them easier to use, more reliable, and more unified as a suite.

PC Graphics & Video, December 1996

At this point, no other graphics program offers the breadth of features or comprehensive automation capabilities found in CorelDraw 7 Graphics Suite.

PC Magazine, February 18, 1997

For the first time in several years, CorelDraw's interface has changed significantly, yielding such innovations as a context-sensitive toolbar that alters according to the drawing tool you're using.

PC World, January 1997



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both browsers without errors.

The secret to creating scripts that use features exclusive to a particular language yet run in either browser is to provide different sets of functions, one set to be executed by Internet Explorer and another to be executed by Netscape Navigator. Because browsers do not validate functions until execution time,



FIGURE 5: By including functions tailored to both Navigator and IE, you can create one script that will run in both browsers.



the separate functions will not cause a browser to report errors. Figure 4 shows the framework for a script I use regularly in Web pages, without breaking either Internet Explorer or Netscape Navigator. As you examine the script, note the use of the `navigator.appName` property to extract the browser name, and also how specific functions are called for use by different browsers.

You can also execute unique functions for different browsers by checking browser name and version information with the `navigator.appName` and `navigator.appVersion` properties. Here, you check for both browser name and version before calling a specific function. But the coding for this can get rather messy; one way to streamline your script is to extract the browser name and version information from the `navigator.userAgent` property, which reports a summary list of browser information. In this way, you only have one property to check instead of two.

You can also ensure that only scripts of the specific JavaScript version supported by the user's browser are executed. Use the `<SCRIPT>` tag for this, for instance:

```
<SCRIPT LANGUAGE="JavaScript">
<SCRIPT LANGUAGE="JavaScript1.1">
<SCRIPT LANGUAGE="JavaScript1.2">
```

Note that because Internet Explorer does not recognize the JavaScript 1.1 or JavaScript 1.2 values, it's usually better to use a function similar to the one shown in Figure 4. In this way, you can allow users with all types of

JavaScript-enhanced browsers to get the most out of your Web page.

Figure 5 shows the result of running a script based on the one in Figure 4 in both Navigator and Internet Explorer. Visit PC Magazine Online to try the script yourself.

As you examine the figure, note that in this instance, Navigator loads the HTML document fully before executing the script. Internet Explorer, on the other hand, gets ahead of itself and executes the script before it finishes loading the page. This behavior demonstrates a subtle difference in how Navigator and Internet Explorer load and display Web pages. Generally, Navigator displays page elements as they are retrieved and Internet Explorer attempts to build the page before displaying it.

SUMMING IT ALL UP

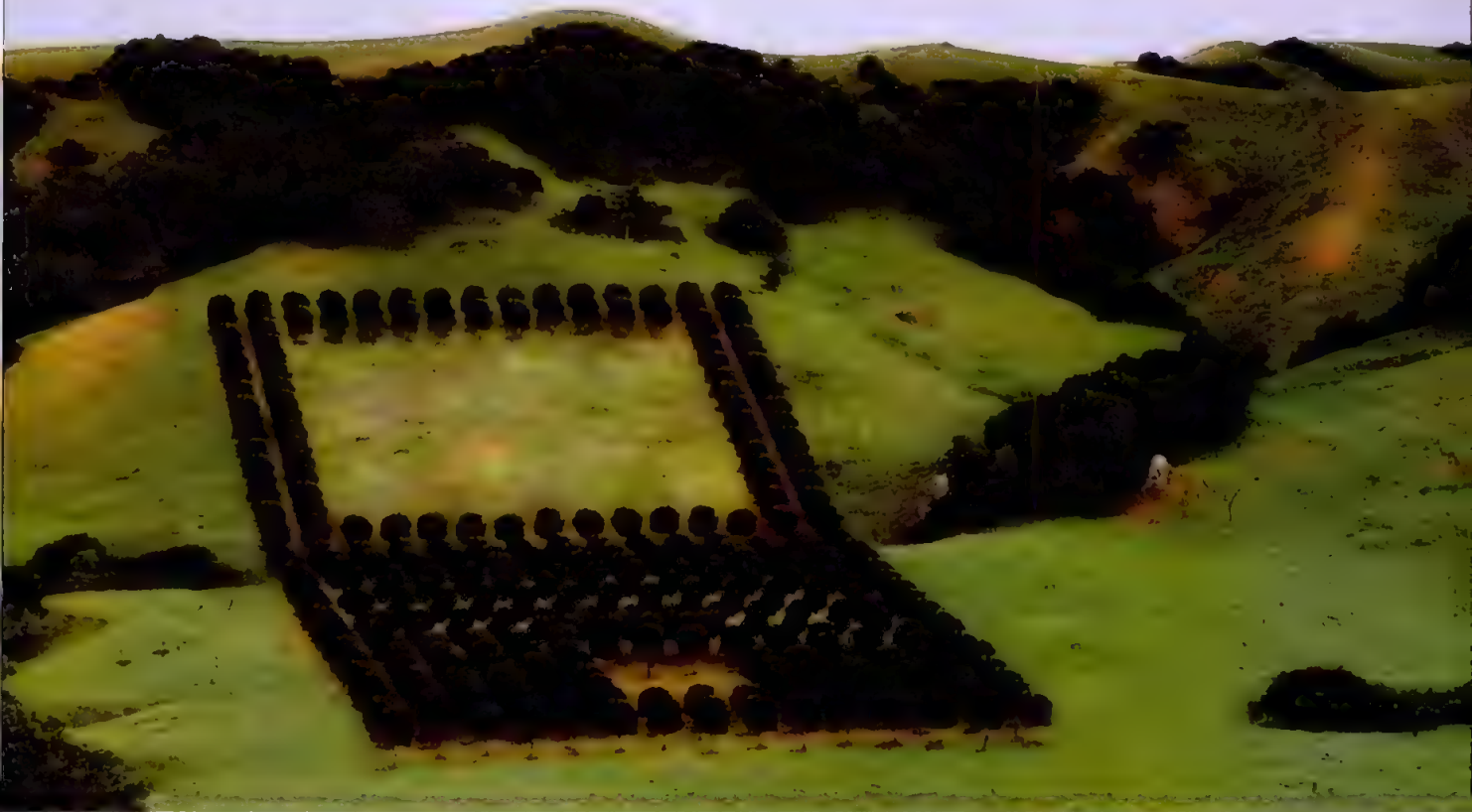
Our head-to-head comparison of JScript and JavaScript reveals as many differences as similarities, and neither is a clear winner. Both JScript and JavaScript have extensive client-side and server-side frameworks, and both offer unique features, functions, and objects. Both implementations clearly have a place in Web scripting.

Still, there are times when you may want to choose one language over the other, especially on a corporate intranet. If you are publishing on an intranet using a Microsoft Web server that supports ActiveX, you'll want to use JScript and Internet Explorer; doing so will allow you to use server-side JScript and ActiveX technologies. On the other hand, if your intranet uses a Netscape SuiteSpot Web server, of course you'll use JavaScript and Navigator so you can use server-side JavaScript and Netscape ONE technologies.

Beyond the intranet environment, you have no control over which browsers visit your Web site. Right now, the best course is to exploit the common features of the two implementations and create scripts that will work with either client. □

William Stanek is the executive director of Global Internet Solutions and author of several books including Web Publishing Unleashed, FrontPage 97 Unleashed, and Peter Norton's Guide to Java Programming. His seventh book from Sams.net, Netscape ONE Developer's Guide, was published in April. He can be contacted at director@tvpress.com.

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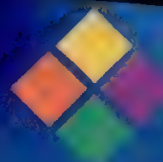
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IPC in Windows NT

Two ways to transfer data across process boundaries in Windows NT.

By Jeff Prosise

What would you say if someone asked you how to write a Windows NT application that talks to another application? If the question stumps you, you're not alone. Interprocess communication (IPC) is a subject that few NT programmers know well. Yet Windows NT supports such a rich assortment of IPC mechanisms that the real question isn't so much "How do I do it?" as "What's the best way to get it done?"

IPC isn't as easy as it used to be. In 16-bit Windows, applications could send messages to each other, and to facilitate data transfers, they could pass pointers in those messages. Windows NT applications can send messages to each other, too, but passing pointers is pointless, because Windows NT runs processes in separate address spaces. A pointer that's valid in the context of one application is meaningless in the context of another. Unless you're using shared memory, letting process B use a pointer passed to it by process A is a sure way to trigger an access violation—or worse, to corrupt process B's data without realizing it. (The same holds true for Windows 95.)

Figure 1 summarizes the various forms of interprocess communication that Windows NT supports. This article discusses two of them: the WM_COPYDATA message, which is great for passing blocks of data from one application to another, and *named pipes*, which let two applications establish a direct line of communication for data transfers. Significantly, applications that use named pipes don't have to be running on the same PC. One (the "server") can run on a network server, and the other (the "client") can be on a workstation. The only drawback to named

pipes is that code that relies on them isn't fully portable to Windows 95, which supports named pipe clients but does not support servers.

THE WM_COPYDATA MESSAGE

The WM_COPYDATA message was added to Windows NT so that applications could pass pointers across process boundaries and use them for transferring data. Before sending a WM_COPYDATA message, you initialize a COPYDATASTRUCT structure with information about the impending data transfer, including a pointer to the block of data. You then use SendMessage to send the target application a WM_COPYDATA message with wParam holding your application's window handle and lParam holding the address of the COPYDATASTRUCT. The target applica-

structure, initializes the structure's cbData and lpData members with the block's size and address, and then sends a WM_COPYDATA message:

```
COPYDATASTRUCT cds;
cds.cbData = (DWORD) nSize;
cds.lpData = (PVOID) pBuffer;
SendMessage (hWndTarget,
WM_COPYDATA, (WPARAM) hWnd,
(LPARAM) &cds);
```

When the target application's WM_COPYDATA handler receives the message, it can copy the pointer out of the COPYDATASTRUCT and use it as it would any other pointer, in the following manner.

```
PCOPYDATASTRUCT pcDs =
(PCOPYDATASTRUCT) lParam;
PBYTE pBuffer =
(PBYTE) pcDs->lpData;
// Use pBuffer...
```

The target process can use cbData to determine the size of the data that is referenced by lpData.

The value that the target application reads from lpData probably won't be the same value that the source application wrote to it. That's to be expected, because before delivering a WM_COPYDATA message, Windows NT allocates a block of memory in the target process's address space, copies the data from the source process, and updates lpData. In all likelihood, the block will reside at different addresses in the two address spaces.

COPYDATASTRUCT contains a third, optional field, dwData, with which you can pass an application-defined 32-bit value. Just don't pass a pointer in it, because that pointer won't work in the target process.

One nuance of which to be aware when using WM_COPYDATA is that WM_COPYDATA messages must be sent, not posted. The system must know when the transfer has been completed so that it can free the memory it allocated in the target process's address space.

IPC MECHANISMS IN WINDOWS NT

IPC mechanism	Comments	Windows 95-compatible
Dynamic Data Exchange (DDE)	Outdated and difficult to implement. Don't use it unless you have to.	✓
Clipboard	Data transfers normally require user interaction.	✓
OLE 2.0	Has built-in facilities for transferring data across process boundaries. Overkill for simple data transfers, however.	✓
WM_USER messages	They work—but don't make the mistake of passing pointers.	✓
WM_COPYDATA messages	Best bet for sending a block of data from one application to another.	✓
Anonymous pipes	Useful for one-to-one communications between two processes running on the same PC.	✓
Named pipes	Useful for one-to-one communications on the same PC or over a network.	Client side only
Mailslots	Useful for one-to-many communications on the same PC or over a network.	Client side only
Sockets	Useful for transferring data to Windows and non-Windows applications alike, whether on the same PC, over a network, or over an intranet.	✓
Events, mutexes, and semaphores	For simple communications—no data transfers.	✓
Remote Procedure Calls (RPC)	Overkill for simple data transfers.	RPC 1.0 only
Shared memory	Not easy to allocate outside of a DLL.	✓
Memory-mapped files	Allow multiple processes simultaneous access to file-mapping object.	✓

FIGURE 1: Windows NT offers a variety of ways to implement interprocess communication.

tion extracts the pointer from the structure and uses it to read the data. The operating system ensures that the pointer is valid in both processes.

Suppose pBuffer is a pointer to a block of bytes that you want to send to another process, nSize is the length of the block in bytes, hWnd is your application's window handle, and hWndTarget is the handle of the other process's main window. The following code snippet creates a COPYDATASTRUCT


```
// In ThrowDlg.cpp
void CThrowDlg::OnSend()
{
    CString string;
    m_wndEdit.GetWindowText (string);

    TCHAR* pString = new TCHAR[string.GetLength () + 1];
    ::lstrcpy (pString, (LPCTSTR) string);

    if (!string.IsEmpty ()) {
        CWnd* pWnd = CWnd::FindWindow (NULL, "Catch");
        if (pWnd != NULL) {
            COPYDATASTRUCT cds;
            cds.dwData = string.GetLength () + 1;
            cds.cbData = (string.GetLength () + 1) * sizeof (TCHAR);
            cds.lpData = (PVOID) pString;
            pWnd->SendMessage (WM_COPYDATA, (WPARAM) m_hWnd,
                               (LPARAM) &cds);
        }
    }
}

// in CatchDlg.cpp
LONG CCatchDlg::OnCopyData (UINT wParam, LONG lParam)
{
    PCOPYDATASTRUCT pcDs = (PCOPYDATASTRUCT) lParam;

    TCHAR* pString = new TCHAR[pcDs->dwData];
    ::CopyMemory (pString, pcDs->lpData, pcDs->cbData);
    pString[pcDs->dwData - 1] = 0; // Just to be sure

    m_wndListBox.InsertString (0, (LPCTSTR) pString);

    delete[] pString;
    return 1;
}
```

FIGURE 2: *Throw's OnSend function and Catch's OnCopyData handler.*

In addition, the recipient of a WM_COPYDATA message should treat the block of data as if it were read-only. If the data is to be modified on the receiving end, the target application should make a local copy. Finally, the pointer passed in lpData should not be stored for later use. It is no longer valid after the WM_COPYDATA handler returns.

For demonstration purposes, I wrote Throw and Catch, a pair of sample programs that use WM_COPYDATA messages to transfer strings across process boundaries. Both programs can be downloaded, complete with source code, from PC Magazine Online (www.pcmag.com); see the sidebar "Getting the Files" in this issue's Utilities column for downloading instructions. Both can be run under Windows NT or Windows 95. To recompile either program, you'll need Visual C++ 4.0 or higher.

To see how Throw and Catch work, start both up and type a string into Throw's edit

control. Click the Send button and the string will appear in Catch's window. The code responsible for the transfer is reproduced in Figure 2. When the Send button is clicked, Throw's CThrowDlg::OnSend function uses CWnd::FindWindow to get Catch's window handle. Then it sends Catch a WM_COPYDATA message, with lpData holding the string address, cbData holding the size of the string buffer in bytes, and dwData holding the string length—including the terminating NULL—in characters. (If Throw is compiled to use Unicode, the string length in bytes will differ from the string length in characters. It's important to initialize cbData with a byte count, not a character count, so that the operating system will know exactly how much data to copy.) Catch's CCatchDlg::OnCopyData handler processes WM_COPYDATA messages by extracting the pointer from lpData, making a local copy of the string, and inserting it into the list box.

NAMED PIPES

WM_COPYDATA messages are fine for passing the occasional block of data to another process, but they don't work so well if the data is flowing in a continuous stream or if the two processes are executing on the same network but not on the same PC.

The ideal IPC mechanism for streaming is the *pipe*. A pipe is a dedicated data channel connecting two processes. What one process writes to a pipe, the other can read from it; the flow of data can be unidirectional or bidirectional. Data is written to a pipe using the Win32 WriteFile function and read from it with ReadFile. If you know how to do file I/O in Windows NT, you know how to do pipe I/O, too.

Windows NT supports two types of pipes: *named pipes* and *anonymous pipes*. Named pipes have names, like filenames. The CreateNamedPipe function creates a named pipe and returns a handle to it. Once a named pipe is created, a client process can connect to it by passing the pipe name to CreateFile. Named pipes may be used to connect two processes running on the same PC or one process running on a network server and another running on a network workstation.

Anonymous pipes don't have names. An application creates an anonymous pipe by calling CreatePipe; in return, it receives a write handle and a read handle. If another application wishes to connect to the anonymous pipe, the first application must pass it a pipe handle. Because Win32 pipe handles are process-relative (another way of saying that, like pointers, pipe handles are valid only in the context of a given process), one of the processes must create a copy of the handle that the client can use. This involves just enough extra work that most programmers prefer to use named pipes, unless the client process is a child process, which can obtain a pipe handle through inheritance. Since anonymous pipes cannot reach out across a network, applications that communicate using them must be running on the same PC.

The two sample applications, PServer and PClient, use a named pipe for one-way data transfers. Once per second, PServer generates a random value from 0 to 10 and sets the length of the bar in its progress control accordingly. If a client process is connected to the other end of the pipe, PServer also writes the random value to the pipe. PClient reads values from the pipe and uses them to update its own progress control. When PServer and PClient are running together, the progress controls move in unison—visible proof that information is flowing through the pipe.

To try out these applications yourself (both



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PCTech Power Programming

```
//
// Create a named pipe.
//
m_hPipe = ::CreateNamedPipe (
    "\\.\pipe\pipcdemo",    // Pipe name
    PIPE_ACCESS_OUTBOUND,  // Write access only
    PIPE_TYPE_BYTE | PIPE_NOWAIT, // Write bytes, no waiting
    1,                     // One instance at a time, please
    0,                     // Output buffer size (bytes)
    0,                     // Input buffer size (bytes)
    0,                     // Timeout value (milliseconds)
    NULL                   // Use default security descriptor
);

//
// Check for failures.
//
if (m_hPipe == INVALID_HANDLE_VALUE) {
    MessageBox ("Unable to create a named pipe.", "Error",
        MB_OK | MB_ICONSTOP);
    return -1;
}

if (m_hPipe == NULL) {
    MessageBox ("Windows 95 doesn't support named pipe servers. " \
        "This application must be run under Windows NT.", "Error",
        MB_OK | MB_ICONSTOP);
    return -1;
}
```

FIGURE 3: The code in PServer that creates a named pipe.

can be downloaded from PC Magazine Online), begin by running PServer, which will create a named pipe. Next start PClient, type the name of the server on which PServer is running in the box labeled "Server" (use the server name "." if PServer and PClient are running on the same machine), and click PClient's Connect button. PClient will attempt to connect to the pipe created by PServer. If the connection is successfully established, PClient's progress control will sync up with PServer's. Do remember that PServer is a Windows NT-only application, since Windows 95 does not support named pipe servers. PClient runs under Windows NT or Windows 95.

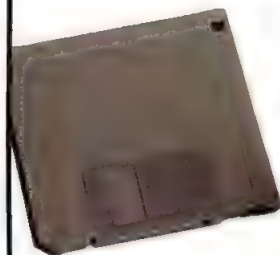
PServer uses the code in Figure 3 to create the named pipe. If CreateNamedPipe returns a valid handle, PServer launches a background thread that writes a continuous stream of bytes to the pipe. Writes are performed as follows:

```
::WriteFile (hPipe, &val, 1,
    &dwBytesWritten, NULL);
```

Before writing to the pipe, the thread calls a local function named IsClientConnected to verify that a client process is attached to the pipe. This conserves bandwidth when



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```
CString strServerName;
m_wndServerName.GetWindowText (strServerName);
CString string = "\\\\" + strServerName + "\\pipe\\ipcdemo";

m_hPipe = ::CreateFile (string, GENERIC_READ, FILE_SHARE_READ,
    NULL, OPEN_EXISTING, FILE_ATTRIBUTE_NORMAL, NULL);

if (m_hPipe == INVALID_HANDLE_VALUE) {
    CString strErrMsg = "Unable to open " + string + ". " \
        "Make sure the Pipe Server application is running on " \
        "server " + strServerName + " and try again.";
    MessageBox (strErrMsg, "Error", MB_OK | MB_ICONEXCLAMATION);
    return;
}
```



FIGURE 4: This PClient code establishes a connection to the named pipe.

PClient is not running; it also prevents the pipe from filling up. (If a pipe fills up, it won't accept further input until data is read from the other end.) Pipe data is buffered in memory allocated by the operating system. CreateNamedPipe lets you declare sizes for the pipe's input and output buffers, but the values you specify are considered advisory only; the system determines the actual sizes. Informal testing shows that specifying 0 for these buffer sizes in Windows NT 4.0 results in buffer sizes of around 1MB.

One rather curious characteristic of Windows NT is that if a client process disconnects from a named pipe, subsequent processes can't connect to the pipe until the process that created the pipe calls the DisconnectNamedPipe API function. PServer calls DisconnectNamedPipe if the connection is broken so that a second instance of PClient can connect to the pipe. How does it know when the connection is broken? Remember that once per second, PServer checks the status of the connection and outputs a byte of data to the pipe only if there's a client on the other end. If PClient is terminated while connected to the pipe, PServer knows about it within a second or so and calls DisconnectNamedPipe.

Figure 4 shows the code that PClient uses to connect to the named pipe. Once the connection is established, PClient starts a background thread of its own that continuously reads bytes from the pipe and transmits the data to the main thread via PostMessage:

```
BYTE byte;
DWORD dwBytesRead = 999;

while (dwBytesRead && ::ReadFile
(hPipe, &byte, 1, &dwBytesRead,
NULL))
{
    ::PostMessage (hWnd,
        WM_USER_UPDATE, (LPARAM) byte, 0);
}
```

The main thread responds to WM_USER_UPDATE messages by updating the progress control. For its part, the background thread loops forever, unless PServer is terminated and the connection is broken. If that happens, ReadFile returns FALSE, the while loop falls through, and the thread posts a WM_USER_CONNECTION_LOST message to the main thread, notifying it of the broken connection. The main thread responds by reenabling the Connect button so that the connection can be reestablished if PServer is restarted.

When PServer creates a named pipe, it uses the PIPE_TYPE_BYTE flag to create a *byte pipe*—a pipe that is read and written in units of 1 or more bytes, just like a file. Windows NT also supports *message* (PIPE_TYPE_MESSAGE) pipes, which transact groups of bytes comprising messages. Messages may be written to and read from a message pipe with the API functions CallNamedPipe and TransactNamedPipe. If you would like more information on the use and operation of message pipes, see the Win32 SDK documentation for these functions.

CHOICES, CHOICES . . .

Pipes are always used for one-to-one communication; a single pipe can't be used to connect more than two processes. If one-to-many communication over a network is your goal, use mailslots instead. For fast IPC between two processes running on a Windows 95 machine, memory-mapped files are an ideal medium. As you can see, Win32 operating systems have an IPC mechanism to fit every need. □

Jeff Prosis is a contributing editor of PC Magazine and the author of Programming Windows 95 with MFC, published by Microsoft Press.



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A New Standard in Windows 3-D Testing

We introduce 3D WinBench 97 with this issue's roundup.

By Mark L. Van Name and Bill Catchings

The Windows 3-D market is shaping up quickly as more 3-D applications are released with better capabilities and 3-D accelerators become commonplace and grow faster. But different 3-D accelerators follow different approaches to improving 3-D performance and provide a variety of rendering option sets that can make a world of difference in how a 3-D scene appears. Consequently, selecting a 3-D accelerator that will prove a good choice today—and tomorrow—can be a daunting task.

Thus, with the graphics accelerator roundup in this issue (see "3-D Shoot-out"), PC Labs introduces 3D WinBench 97, a benchmark program designed to measure the performance of a PC's 3-D graphics subsystem. This program, the latest addition to the Ziff-Davis desktop PC benchmark-test family, is the product of PC Magazine's sister organization, the Ziff-Davis Benchmark Operation (ZDBOp).

The program measures 3-D graphics performance by using the Windows Direct3D API to render 3-D scenes similar to those found in games. The test scenes reflect both the rapid rate of change in the 3-D market and the fact that the most common Windows 3-D applications today are, in fact, games. To make sure that the adapter you buy today will work well tomorrow, 3D WinBench employs not only scenes like those in current games but also more complex scenes like those you can expect to see in games released over the next year or so.

3D WinBench 97 provides an overall score, the 3D WinMark 97, plus results from a variety of other 3-D performance tests.

QUALITY AND PERFORMANCE

One of the most important aspects of testing any 3-D accelerator is determining exactly which 3-D features that accelerator provides. 3D WinBench 97 attempts to make this determination the same way games do—by querying Direct3D to learn which 3-D features the accelerator can provide in hardware via the HAL (Hardware Abstraction Layer)

and which features require the HEL (Hardware Emulation Layer). This knowledge is vital and carries huge performance implications because the HEL, an entirely software-based system, delivers 3-D features much more slowly than the hardware-based HAL.

The way an application must handle this rendering of information is tricky, and has pro-

cause Direct3D's HEL cannot display MIP-mapped images, an accelerator (or its device driver) that does not support MIP mapping will not display the scene.

But wait, it gets even worse! Some Direct3D drivers available today may claim to provide a 3-D rendering feature but actually implement it incorrectly or not at all. For example, during the testing for this issue, some drivers came with claims that they could provide specular highlighting. But a scene involving this feature appeared no different with or without specular highlighting enabled. Similarly, one accelerator's driver purportedly implemented fog, but our testing found the fog to be black when it should have been white. In all cases, implementing these scenes using the HEL instead of the HAL resulted in the correct behavior.

To help our testers—and you—accurately determine the rendering options of a 3-D accelerator, 3D WinBench 97 provides a 3-D quality verification suite. This suite shows how a scene should appear if an accelerator implements the associated features correctly. You can compare that image with the one an accelerator actually provides (see Figures 1 and 2). We wish the program could do all the work for you, but unfortunately testers still must make this determination because Direct3D currently provides no precise definition of how a pixel should appear. Though it might be easy, for example, for a program to check whether fog is black or white, it is not as easy to determine whether the fog is good enough for a typical observer to believe the accelerator has implemented fog correctly. Thus, until Direct3D offers a precise definition of what the correct value for each pixel should be, a skilled tester's examination will be necessary.



Figure 1: 3D WinBench 97 includes a 3-D quality verification suite that lets you verify that a 3-D card correctly implements various 3-D features. Here the program shows how an image should look with correctly implemented fog vertex and transparency using alpha-blending.



Figure 2: Here the tester has indicated that this 3-D adapter did not correctly implement the combination of fog vertex and transparency using alpha-blending and is entering an explanatory note into the Comments field.

found implications for performance. Because of the design of Direct3D, if an accelerator does not support with hardware acceleration all the 3-D rendering options a scene employs, 3D WinBench 97—or any application—must display the entire scene using Direct3D's HEL. No application can choose to implement some of a scene's rendering options with the HAL and others with the HEL. It's all or nothing.

Things get worse if an application, including WinBench, tries to use MIP mapping. Be-

ARRIVING AT AN OVERALL SCORE

Scene quality is so vital to 3-D that 3D WinBench, unlike other 3D benchmark programs, goes beyond just measuring performance: It combines performance and quality capabilities in its tests. The main score 3D WinBench 97 produces, the 3D WinMark 97, is a measure of overall 3-D performance and rendering/quality options.

The benchmark test produces this score by displaying a series of 10 scenes, each running at 640-by-480 resolution with 16-bit color. These scenes exercise the 3-D subsystem basically the way games do. Because most Windows 3-D games currently shipping or under development use Direct3D's Immediate

Highlights: 3D WinBench 97

With 3D WinBench 97, you can measure the performance of a PC's 3-D graphics subsystem by displaying a series of scenes that vary in both complexity and the set of 3-D rendering features they employ.

- 3D WinBench 97 provides an overall performance and quality measure, called 3D WinMark 97, which reflects the demands of both today's and tomorrow's 3-D applications.
- To compute the 3D WinMark 97, 3D WinBench 97 displays a series of ten game-like scenes of varying complexity and quality levels.

Mode API, 3D WinBench 97 also uses that interface to render its test scenes.

These scenes stress a variety of the features of a 3-D accelerator. They vary both in complexity—the number of triangles they draw in the course of displaying their images—and in the number of rendering, or quality-enhancing, options they employ. The complexity of the scenes the 3D WinMark tests employ ranges from 900 to about 6,300 triangles per frame. This range represents the complexity levels of both today's games and those that will debut in the coming months.

In some scenes, the benchmark test uses only the minimal set of quality options most games consider necessary for decent appearance: Point-sampling, perspective correction, and Z-buffering. In other scenes, it applies more powerful—and demanding—quality options, such as bilinear filtering, fog, specular highlighting, and MIP mapping.

As it displays each of these scenes, 3D WinBench determines the frame rate (the number

of frames per second the system renders). It then takes the average (technically, the arithmetic mean) of the 10 individual frame rates. Finally, it scales that result to the result of a base machine, a PC with a 200-MHz Pentium CPU and no hardware 3-D acceleration, to produce the 3D WinMark 97 score. The benchmark program sets the score of the base system, whose lack of hardware acceleration forces it to display all the non-MIP-mapped scenes via the HEL's software emulation, to 10.0. (By not providing hardware acceleration for MIP mapping, the base system could not, as we explained above, display the MIP-mapped scenes.)

It is vital to note that these ten scenes do not comprise a typical benchmark-test workload like those you can find in our own WinBench 97 or Winstone 97. Instead, they represent a spectrum of 3-D rendering features and complexity levels. Consequently, combining them into an overall score using the usual harmonic mean method for combining rates (such as frames per second) is not appropriate. Using such a metric

- The complexity of those scenes—the number of triangles each renders—ranges from 900 to about 6,300 triangles per frame.
- A 3-D quality verification suite helps you evaluate whether a 3-D adapter correctly implements various rendering features.
- Test scenes employ a wide variety of 3D rendering features, such as bilinear filtering, transparency, fog, specular highlighting, MIP mapping, and Z-buffering.
- Like most Direct3D games, 3D WinBench 97 uses the Immediate Mode API of Windows' Direct3D interface.

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would mean that an accelerator that did poorly on one scene (perhaps by having to use the HEL because a scene involved fog or specular highlighting) would have an unrealistically low 3D WinMark 97 score. That's why 3D WinBench 97 amalgamates the frame rates using a simple arithmetic mean. Basically, this approach gives each accelerator credit for everything it can do.

COMPARING SCORES IN A MEANINGFUL WAY

The good news with scoring is that higher 3D WinMark 97 scores are better than lower scores. The "bad" news is that the scores don't have a simple linear relationship. You can't, for example, correctly conclude that an adapter that receives a score of 100 is twice as fast as one that scores 50. This conclusion would be wrong because the scores include credit for both rendering options and performance.

The accelerator with a 3D WinMark score of 100 might have fared so well, for example, because it had hardware-accelerated MIP mapping and did not have to rely on software emulation to display any of the scenes. The one with a 50 might have done almost as well on the scenes it could render in hardware but had to rely on software for one or two other scenes and could not display the scenes that employ MIP mapping. The adapter scoring 100 is significantly better than the other one, but the gap is due to more than just performance differences.

In addition to the 3D WinMark 97 test, 3D WinBench 97 provides many other tools for exploring 3-D performance. You can look at frame rates for individual scenes in the 3D WinMark 97. You can also change quality settings on those scenes and run them individually to see how the changes affect results. (You cannot, however, change the options 3D WinBench 97 uses to produce the overall 3D WinMark 97 score.)

You can also try additional scenes that come with the program. 3D WinBench 97 even provides a set of triangle inspection tests, which offer various quality settings, that you can use to measure the speed of an accelerator at either setting up triangles for display or actually drawing those triangles on the screen. You can use these tests to verify vendors' claims of how many triangles per second or pixels per second their adapters can display.

As the 3-D market continues to evolve, ZDBOp and PC Labs will work on improved versions of the benchmark program. □

Mark L. Van Name is the vice president of product testing for Ziff-Davis Inc. Bill Catchings is the director of the Ziff-Davis Benchmark Operation, the research and development division of Ziff-Davis that produces the company's benchmark-test products.

How to Get 3D WinBench 97

Like all other Ziff-Davis benchmark programs, 3D WinBench 97 is freely available. You can download it from the ZDBOp Web page (www.zdbop.com) or from the ZDBOp Forum (GO ZDBENCH) on ZDNet, CompuServe Edition. ZDBOp will mail you a copy of the program on CD-ROM for a shipping and handling fee of \$5 (in Canada, \$6; elsewhere outside the U.S., \$7). Just send a postcard to:

Ziff-Davis Benchmark Operation
1001 Aviation Pkwy., #400
Morrisville, NC 27560-8908
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IconEdit: Customize Your Desktop

Create custom icons for the shortcuts on your desktop.

By Michael J. Mefford

When you place a shortcut on the Windows 95 desktop, the system displays the default icon for that shortcut. For Windows applications, the displayed icon is the first one embedded within the application. For DOS applications, folders, documents and the like, which don't have icons embedded within them, Windows chooses an icon from its arsenal that best fits the case. In most circumstances, a shortcut's default icon is adequate, serving the purpose of conveying the object type at a glance. But if you're finicky, as I am, about the decor of your desktop, you may be dissatisfied with the default icons' aesthetics.

If none of the icons available to you are quite to your liking, you can create your own with this issue's utility, IconEdit. If you have an icon that is close to what you want, but you still see room for improvement, you can use IconEdit to tweak the existing icon, instead of starting from scratch. IconEdit is a 32-bit utility that runs under Windows 95 or Windows NT 3.51 or higher. You can obtain IconEdit by downloading it from PC Magazine Online or by mail. Refer to the sidebar "Getting the Files" for details. The source code for IconEdit, which was written with Delphi 2.0, Borland's visual programming tool, is provided for those interested in seeing how it works.

CHANGING DESKTOP ICONS

It's easy to redecorate your desktop by changing shortcut icons. All you have to do is right-click on the icon and select Properties from the pop-up menu. On the Properties sheet, select the Shortcut tab for Windows applications or the Program tab for DOS programs. Next, click the Change Icon button. If you're changing the icon of a Windows appli-

cation and the executable contains more than one icon, you'll see the alternatives displayed on the Current Icon slider. For DOS applications, you'll see alternative choices from one of Windows' icon storage files. To change the icon, click on one of the displayed icons and then click OK. Click OK again on the Property sheet, and your shortcut will use the icon you selected.

You can also click the Browse button from the Change Icon dialog to select an icon from another file. Windows has several icon storage files, with a large selection of icons to choose from. The files can be found in either

IconEdit

IconEdit lets you create and modify Windows 95 desktop icons and rescales them as needed.



the Windows directory or the Windows\System directory: Moricons.dll contains icons for DOS programs, Pifmgr.dll contains miscellaneous images, and Shell32.dll contains icons for documents or folders. You can use any of those icons for any purpose, but if none of them meets your needs, IconEdit can help.

IconEdit supports 32-by-32 icons (the size of the icons that appear on the desktop) with 16 colors (the most commonly used color depth). Although Windows uses icons of other sizes, it rescales icons as needed, so the limitation won't affect you much. If you change the icon of a Desktop shortcut and place it in your Start menu, you will see a

scaled-down, 16-by-16 version of the icon in the Start menu.

You should be aware, however, that if you change the icon for a Windows program, the new icon will be visible only on the Desktop, on the Start menu, and in Explorer windows. When you run the program, the original icon compiled with it will appear on the Taskbar or in the tray. (DOS programs will use the new icon, because they have none embedded within the executable.) The only way to get a Windows program to use the new icon is to recompile it with the new icon or use a resource editor, such as Borland's Resource Workshop.

USING ICONEDIT

To install IconEdit, copy the program files Iconedit.exe and Iconedit.hlp to a folder on your system. Simply double-click on IconEdit's own icon to launch the utility. When you launch IconEdit, you'll see a toolbar on the left with an empty editing window on the right. Select File | New to create a new icon or File | Open to load an existing icon for editing.

The editing window displays two representations of the icon: a large square eight times bigger than the actual icon and a small, actual-size square to its right. The large square is where the editing takes place. New icons appear as solid green, with a black square surrounding each pixel representation (see Figure 1). The pixels are, of course, eight times actual size, like the square itself, for ease of editing. The green background is not actually the starting color of the icon but instead represents the transparent "color" (more on transparency in a moment).

The toolbar has eight tools: capture, pencil, fill, line, hollow and filled rectangle, and hollow and filled ellipse. They will be familiar to anyone who has used a paint program. The default tool when you start editing an icon is the pencil, since that's the tool you'll probably use the most. The pencil lets you color one pixel at a time. To change a pixel, place the point of the pencil cursor over a pixel in the big editing square and click. You can draw several pixels at once by dragging the pencil over an area.

The two large color squares right under the tools are the current colors for the left and

FOR PROGRAMMERS ONLY IconEdit was written with Delphi 2.0, Borland's visual programming tool. The full source code is available from PC Magazine Online. In it, you'll find a demonstration of the following programming techniques:

- how to read and modify the structures that define an icon;
- how to maintain an icon's transparency and reverse color properties during editing; and
- how to create a circular buffer for undoing edits.

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right mouse buttons, respectively. When you launch IconEdit, the left mouse button color is black and the right mouse button color is white. If you click with the left mouse button on a pixel with the pencil tool, for example, the pixel will turn black. Click with the right mouse button and the pixel will turn white. To change the default colors, click on one of the 16 colors in the palette just below the current color boxes with either the left or right mouse button. Clicking on a palette color with the left button will change the left button color, and a right button click will change the right button color.

SPECIAL ICON COLORS

An icon is a bitmap with two additional special properties. Pixels of an icon not only can be a specific color; they also can be transparent or reverse screen color. A transparent pixel lets the background color of whatever the icon is over show through. A reverse screen color pixel takes on the opposite color of whatever the icon is over. Both IconEdit's large editing square and the actual icon-size square are ordinary bitmaps *without* transparent or reverse screen color capabilities.

The display of transparency and reverse screen color during editing would cause a substantial performance hit, so IconEdit instead substitutes fixed colors for transparent and reverse screen colors. IconEdit uses dark green in the editing bitmap to represent transparency. When you start editing a new icon, all the pixels are transparent, in effect forming a blank canvas for you to draw on. If you choose to draw with the dark green color over the dark green representing transparency, it will look as though nothing has changed in the editing window. The pixels that you painted have, however, changed from transparent to dark green. You can see this change by selecting Test Icon from the Icon menu (see Figure 2). In the Test Icon window you'll see the icon as a true icon. The dark green "transparent" pixels turn into true transparent pixels, letting the background color show through, and the pixels that you painted dark green will be dark green. You can select different window colors to see how the icon looks against different color backgrounds.

The opposite color of green is red, so that's the color used by IconEdit to represent reverse color. You can draw with both the transparent color and the reverse screen color by selecting them from the two color wells at the bottom of the toolbar. You select these special colors the same way you select the regular palette colors (by clicking on them). To

help remind you that you're now using these special attributes, a "T" will appear in the current color square when you select transparent and an "R" will appear when you select reverse color.

As with transparent color, when you draw in reverse color you won't be able to tell the difference between a true red pixel and a red reverse screen pixel in the editing window. However, if you test the icon, the red pixels will stay red and the reverse pixels will take on the opposite color of the background. If you change the background color in the test window by clicking on a different color in the window color palette, you'll see the background change and the reverse color pixels change to the opposite color.

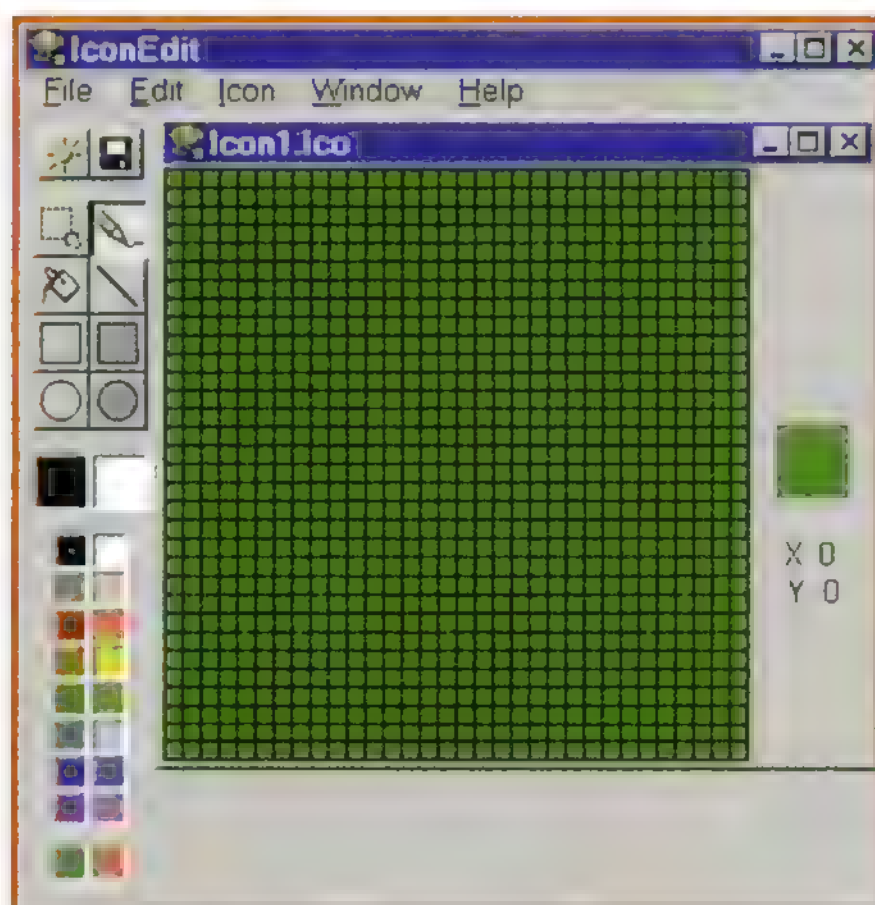


FIGURE 1: The dark green background for new icons actually represents transparency.

The transparent color is usually used as the background for the icon image. When you create a new icon, you're already a step ahead in this effort, since all the pixels default to transparent. All you have to do is add your color.

The reasons for using reverse color are a little less obvious. You can't know ahead of time what color a reverse pixel will take on. If you change the color of the desktop, the reverse pixels in your icon will change also. It seems, therefore, that using the reverse color is a disadvantage, since you have no control over what color it will end up. But what you do know is that reverse color pixels will always be visible, because they'll contrast with whatever they're over. One use of the reverse color is as a border for your icon. No matter how you change your desktop colors, a reverse color border will always stand out.

EDITING TOOLS

I've already discussed the use of the pencil. To change editing tools, simply click the tool button of your choice. The fill tool (represented by a paint can) will color the pixel you point to and all adjacent pixels of the same color with the color you've selected. The remaining tools all operate in the same way. You click and hold the mouse button at the starting pixel position, drag the mouse to an ending position, and release the mouse button. For example, to draw a line, you click and hold the mouse button on the starting point for the line and drag to the ending point. As you drag the line will stretch between where you started and the current ending position. Only when you release the mouse button will the line be permanently drawn. For a rectangle or an ellipse you drag from one corner to the opposite corner.

You control the color that the tool uses by pressing either the left or right mouse button.

The capture tool is in a category by itself, since it's not a drawing tool like the others. The capture tool lets you select a rectangular set of pixels for manipulation. To capture a rectangular set of pixels, drag the mouse over the pixels as if you were drawing a rectangle. When you let go of the mouse button, there will be a dotted white line around the captured pixels. Once it is captured, you can move, copy, or cut the pixel block.

To move the captured pixels, place the cursor within the dotted line rectangle. The cursor will change to a grabbing hand. You can now move the captured pixels

to a new position by clicking and holding down the mouse button as you drag. The block of pixels you drag will remain at the old location and will also appear at the new location. (If you cut and paste, it works differently; see below.) As long as the dotted line is around the pixels, you can drag and release, drag and release until you're satisfied with the new position. When you change tools or start a new capture, the dotted line will disappear and the captured pixels will become part of the new position.

Pressing Ctrl-C or selecting Copy from the Edit menu will copy the captured pixels to the Clipboard. You can subsequently paste the pixel block back into the icon. When you paste, the pixel block will appear in the upper left corner with a dotted line around it. You can then move the block around as described above.

You can work on multiple icons and copy and paste between them. But be warned

that any transparent or reverse pixel information will be lost in the copy and paste process, because the Clipboard doesn't store such information. Transparent pixels will be pasted as black and reverse color pixels will be pasted as white.

If you press Ctrl-X or select Cut from the Edit menu, the captured pixel block is replaced by transparent pixels. The cut pixel block is transferred to the Clipboard, so you can paste it back if you need to.

You can quickly select all the pixels in the icon by selecting Select All in the Edit menu or by pressing Ctrl-A. IconEdit has 20 undo buffers that hold the last 20 drawing changes. Press Ctrl-Z or select Undo from the Edit menu to go backward in the editing session. You can turn off the black pixel outlines in the zoomed edit box to get a cleaner picture of the icon by unchecking Show Pixels in the Icon menu, but you won't be able to tell as easily where the individual pixels are.

To load an existing icon for editing, select Open from the File menu. You can save an icon you've edited by clicking the disk button at the top of the toolbar or by selecting Save in the File menu. If you obtained the icon from within an .EXE or .DLL file, it will be saved as an icon file (.ICO); the file from which you obtained it will not be altered.

PROGRAMMING ICONEDIT

I didn't want to reinvent the standard bitmap drawing tools for IconEdit. I wanted to use the Windows API drawing commands like `LineTo`, `Rectangle`, and especially `FloodFill`, which have fast, efficient algorithms to calculate pixel drawing. Using these drawing commands on a standard bitmap is very easy. All you do is pass them the drawing coordinates, and the command figures out which pixels should be drawn. In general this worked fine, but I ran into some problems using `FloodFill`, because of the special properties of transparency and reverse color. In a moment I'll explain what the problem was and how I solved it, and I'll also tell you how IconEdit creates the illusion of drawing on the zoomed bitmap and how I implemented the undo buffer. But first a primer on how icons are stored and displayed.

ICON BASICS

Icons can be different sizes and color depths. For example, Explorer's small icons are 16-by-16, while the large icons are 32-by-32 (desktop icon size). Black-and-white versions of icons are used by monochrome notebooks. Other color depths are possible as well. All the different images of an icon are stored together in the icon resource, and Windows uses whichever one it needs in different situations. If a

particular type is not available, Windows will adapt what's there to meet the display requirements. So, for example, if an icon file contains only a 32-by-32 icon image and Windows needs a 16-by-16 icon image, it will shrink the larger icon to 16-by-16. IconEdit supports only 32-by-32 icons with 16 colors, so my discussion will focus on this size and color depth.

Since an icon file can contain multiple images, the first structure found in an icon file is a directory. The directory is made up of just three words: the first is reserved and must be 0, the second is a code for the type of resource (a value of 1 indicates an icon resource), and the third is the number of images contained within the file. The directory is followed by a series of icon directory entries, one for each image in the file. The first three bytes of each icon directory entry indicate the image's width, height, and number of colors. When IconEdit searches an icon file for an image it can display, it looks for the values 32, 32, and 16, respectively, for these entries. The last element in the icon directory entry is a double word that holds a pointer to the icon's image offset in the file.

The icon image consists of four structures: a bitmap information header, a color table, an XOR mask, and an AND mask. The bitmap information header is a standard structure that repeats the dimension and color depth information found in the icon directory entry. The color table structure is the palette for the icon and has 16 entries for 16-color icons. Each entry contains the red, green, and blue values for a particular color. The last two structures, the XOR mask and the AND mask, tell Windows how to draw the icon.

The AND mask, a monochrome bitmap with a single bit for each pixel, controls transparency and reverse color. The bits are stored in rows starting with the bottom row—standard for bitmaps storage. The XOR mask, which contains indexes into the color table for each pixel in the icon, is also stored bottom row first. For 16-color icons, each XOR mask entry requires 4 bits, or a *nibble*, since 4 bits can take on values from 0 to 15.

Here's how Windows uses this information to draw an icon on the desktop. The AND mask contains 1s for all transparent or inverted pixels and 0s for all other pixels. The AND mask is logically ANDed with the destination portion of the desktop. Anything AND 0 is 0, so where the AND mask contains 0s the background is erased. Anything AND 1 is unchanged, so where the AND mask contains 1s

the background is unchanged. The XOR mask contains the actual image, with transparent areas holding all 0s and inverted areas holding all 1s. When the image portion is XORed with the blacked-out portion of the background, those pixels are copied unchanged, because anything XORed with 0 is unchanged. When the all-0s portion is XORed with the unmodified background, the background is unchanged, for the same reason. And when the all-1s portion is XORed with the background, the background is inverted. This assumes that the first entry in the palette table is black (all 0s), and the last entry is white (all 1s).

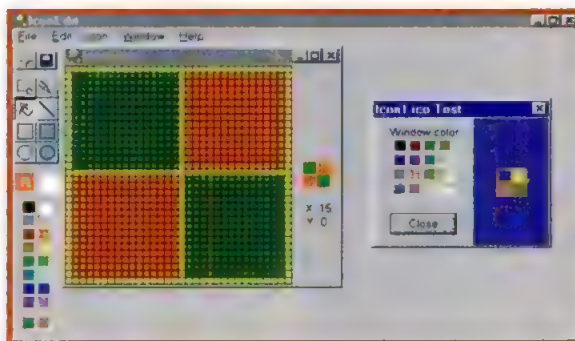


FIGURE 2: The test window shows that the upper-left portion of the icon is transparent, while the upper-right portion is inverted.

DRAWING LOGIC

You can't draw directly onto an icon, but you can draw an icon on a Delphi image canvas and then use Windows API drawing functions to modify the image. In general, this logic works:

1. Use the icon's XOR mask and AND mask to draw the icon as an image;
2. use Windows API drawing functions to modify the bitmap image;
3. monitor the changes and update the icon's XOR and AND masks to reflect them.

This approach works with all the drawing functions used by IconEdit except `FloodFill`. `FloodFill` uses the current drawing color to fill an area starting at a given point. IconEdit uses a `FillStyle` of `fsSurface` and sets the method's color parameter to the color of the starting pixel. Used in this way, filling continues in all directions until `FloodFill` encounters a color different from the starting point's. `FloodFill` works correctly with all the standard palette colors but has problems with transparent and reverse colors, because it cannot distinguish them from the palette colors used to represent them.

Recall that transparent pixels are represented on the image canvas as dark green and reversed pixels are represented as red. If a transparent pixel is adjacent to a dark green pixel and the user fills on the dark green pixel, both the dark green pixel and the adjacent transparent pixels will be filled with the draw-

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ing color. Similarly, filling on a red pixel adjacent to reverse screen pixels would give faulty results.

The solution was to isolate the current pixel color on an invisible working image. The logic goes like this:

1. When the user clicks the mouse on the edit icon image, retrieve and save the color of the pixel under the mouse pointer.

2. Look in the palette for a color that is neither the current pixel color nor the current drawing color—a neutral color that will act as a FloodFill border color.

3. Use FloodFill to fill the 32-by-32 working image with the neutral color, then copy to the working image all pixels from the icon's XOR mask that precisely match the saved current color, distinguishing the transparent and inverted colors from the colors used to represent them. All pixels other than those matching the saved current color will be the selected neutral color.

4. Use FloodFill on the working image. The fill will proceed from the chosen starting point until it reaches the neutral color.

5. Copy all pixels that were changed by this process back to the edit icon image.

An example will help illustrate this point. Suppose the icon is completely transparent (represented by dark green) except for a dark green empty circle. The user clicks in the center of the circle to fill it with blue. IconEdit creates a working image and uses as its background color anything other than blue or dark green; let's say it uses red. It then copies every pixel from the icon that matches the current pixel's color (transparent) to the working image.

The working image now contains a red circle on a dark green background. FloodFill changes the interior of the circle to blue.

IconEdit copies only the blue pixels back to the original image. Again, all of this is made necessary by the fact that transparent and inverted pixels in the icon must be represented by ordinary colors during the editing process.

DRAWING ILLUSION

Drawing directly on the large, zoomed icon edit square is an illusion. Drawing is actually done on the invisible 32-by-32 working image, as just described. The coordinates of where the drawing takes place are calculated

Drawing directly on the large, zoomed icon edit square is an illusion.

Drawing is actually done on the invisible 32-by-32 working image.

according to the cursor position on the zoomed icon edit square. After drawing on the working image, the results are stored in the icon's XOR and AND masks. Then the revised icon is drawn a pixel at a time on another invisible 32-by-32 image I called ShadowIcon. This ShadowIcon is then copied all at once to the visible small edit image to the right of the zoomed icon edit square. The reason the icon is copied to the invisible ShadowIcon first is because invisible images are not updated by Windows. If we painted one pixel at a time directly onto the visible image, the screen would be updated with

each pixel drawn. And with 1,024 screen updates per icon, IconEdit would turn into a snail. By drawing on the invisible image one pixel at a time and then copying all the results at once to the visible image, we have only one screen update, and IconEdit turns into a jackrabbit.

After drawing the actual-size icon image, IconEdit uses Windows' speedy StretchBlt function to copy the actual-size image to yet another invisible image, called ShadowImage, that's the same size as the zoomed icon edit square. StretchBlt copies a bitmap from a source rectangle into a destination rectangle, stretching or compressing the bitmap to fit the dimensions of the destination rectangle. In IconEdit's case, the bitmap is stretched to fit ShadowImage's large zoomed size. It's done on an invisible image because the stretch isn't the last step. If Show Pixels is checked, IconEdit has to draw in the defining black pixel lines. Also, IconEdit at this time draws the enclosing white dotted line around any pixels that are currently selected. Again, drawing these lines on a visible image would cause a screen update with each line draw, which would slow IconEdit down. Once the ShadowImage is complete, it is copied all at once to the visible icon edit square and the illusion is complete.

The last thing I did was to create the icon for the editor itself—the proof in the pudding. I used all the drawing tools. If you don't like the icon I created, you can create your own, just as you can for any other application. Have fun redecorating your desktop! □

Michael J. Mefford is a contributing editor of PC Magazine.

Sheryl Canter is editor of the Utilities column and a contributing editor of PC Magazine.

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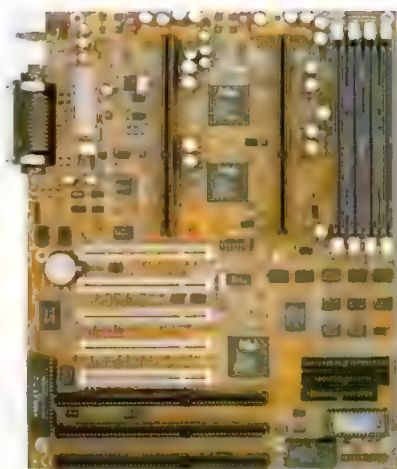
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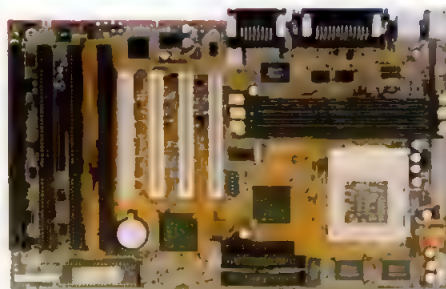
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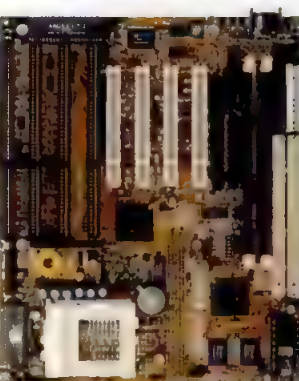
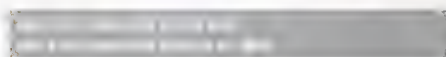


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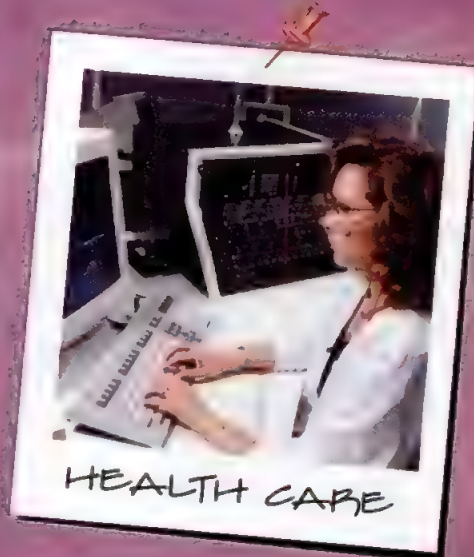
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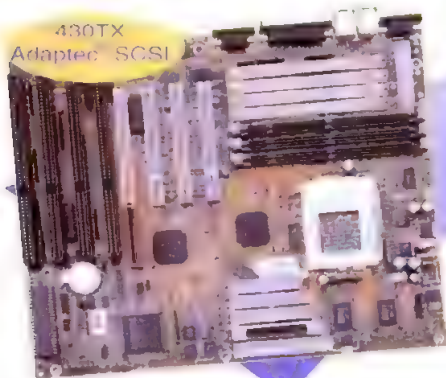
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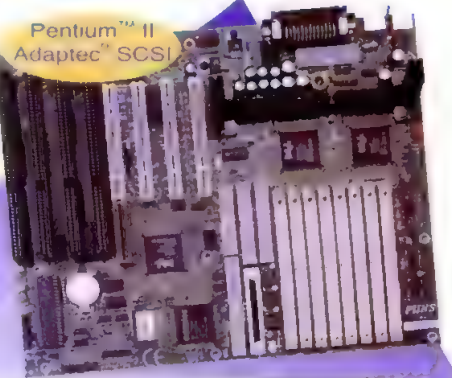
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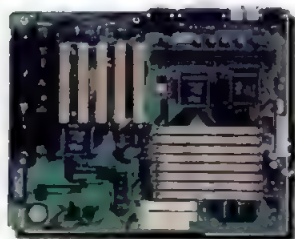
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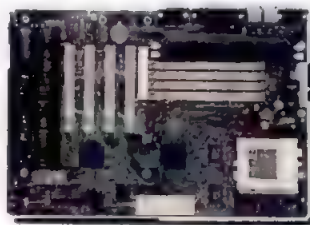
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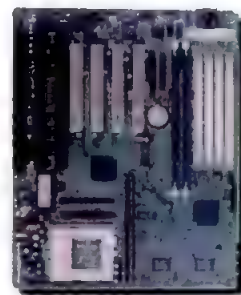
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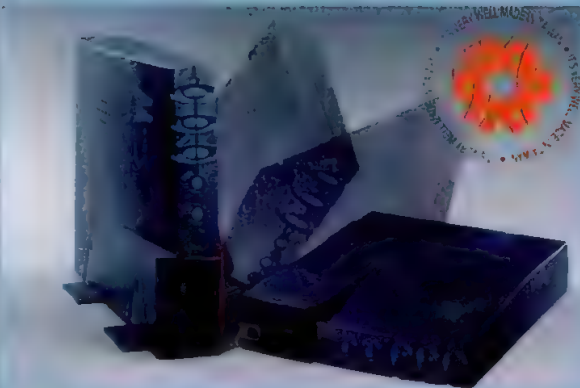


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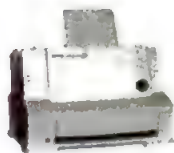
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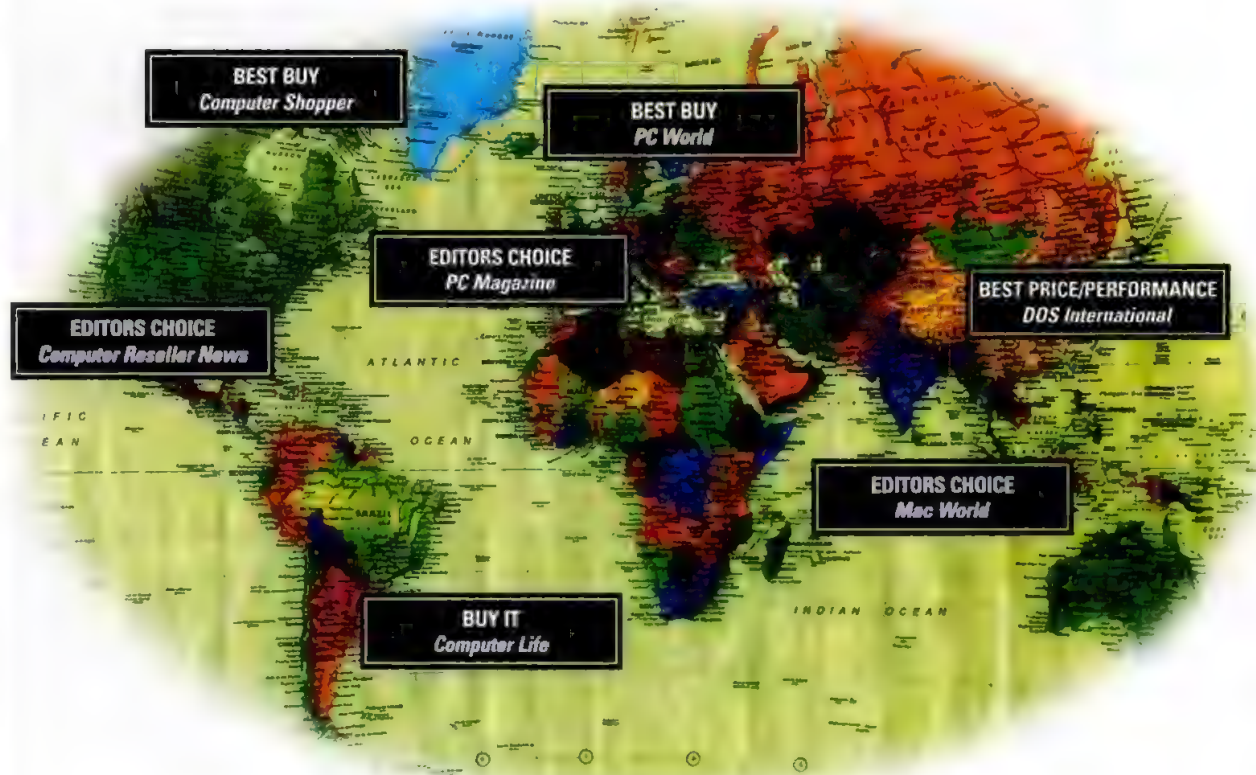
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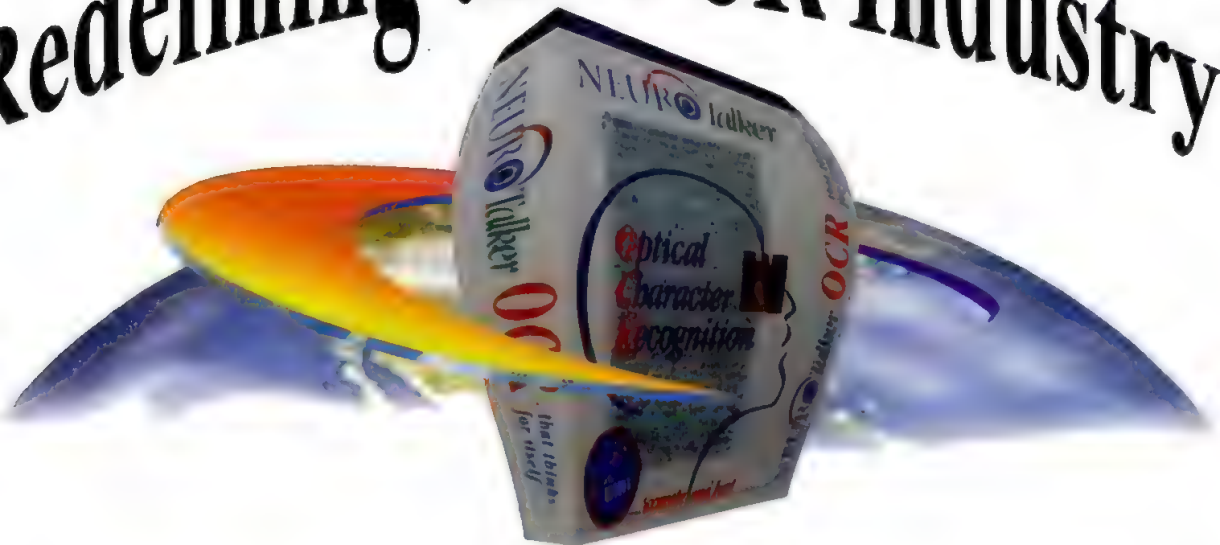


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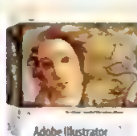
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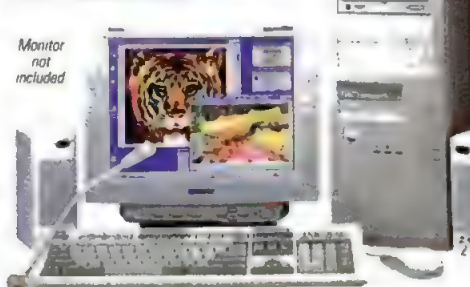
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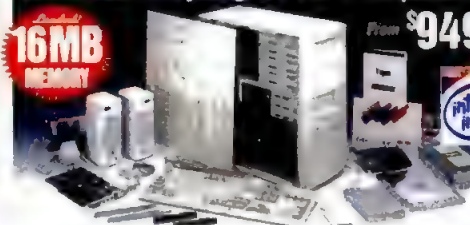
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Kiwi 166MHz Pentium MMX

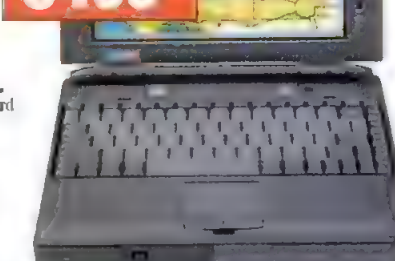
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166MHz Pentium MMX
\$3499⁹⁹



Item#	OpenNote	CPU	RAM/MAX	HD/CD	Monitor Size	Modem	Price
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K28-1502	680C	133MHz Pentium	16/128	1.1/6x	11.3" Dual Scan	33.6	\$1999.99
180C Series							
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A113-5020.2

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\$2749⁹⁹
A113-5030.2

Item#	Processor	RAM/Exp. To	HD	CD	System	Screen	Price
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A113-5020.2	Cyrix 6x86 PR166+	16MB EDO/80MB	1.6GB	10X	Windows 95	12.1" Active Matrix	\$2,499.99
A113-5030.2	Pentium 166MMX	16MB EDO/80MB	1.6GB	10X	Windows 95	12.1" Active Matrix	\$2,749.99

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BY NEIL J. RUBENKING

Changing Windows 95 Icons

Recently, I've been using my free time to map the Windows 95 Registry in an attempt to find out what each key and value does. While doing this I've found that you can change all of the default icons Windows uses—even the Start menu icons. To do this, launch the Registry Editor and go to `HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\explorer\Shell Icons`. As shown in Figure 1, in the right pane, you should see some or all of the numbers from 0 to 40, depending on whether you have Microsoft Plus! for Windows 95 installed. Figure 2 shows the values I've mapped so far.

After you change the icons you want, restart the computer in DOS mode. Then go to the Windows directory, delete the file called `Shell-IconCache` (in DOS, the filename is `SHELLI-1`), then reboot. As its name implies, this file is a cache that holds all the shell icons. If you don't delete it, Explorer uses the cached icons, and your changes will not take effect.

CHRIS P. OLER
via the Internet

PC MAGAZINE: Glance down the Default column in Figure 2 and you'll notice a pattern. Each numbered value in the Registry corresponds, by default, to the icon in `Shell32.dll` that has the same number. Upon installation, Microsoft Plus! for Windows 95 installs the

file `Cool.dll` and replaces many of the defaults with new icons from this file. (Apparently someone at Microsoft considers the new icons to be "cooler" than the old.)

The desktop themes that form part of the Microsoft Plus! pack add yet another layer to the shell-icon puzzle. Although the Registry key that defines shell icons will show that My Computer, Network Neighborhood, and the Recycle Bin use icons drawn from `Cool.dll`, you'll find that completely different icons are what's actually displayed. In the case of these three particular shell icons, a setting elsewhere in the Registry overrides the Shell Icons key.

This tip also provides the answer to the common question of how to change the folder icon used in Windows Explorer. The standard technique for changing the icon associated with a particular file type is to open the View | Options dialog in Explorer, highlight the file type in question, and press the Change Icon button. If you do this for the Folder file type, though, your changes have no effect. To change the folder icon successfully, change values 3 (Closed Folder) and 4 (Open Folder) in the Shell Icons Registry key.

As noted above, you must force Windows to reread its shell icons in order for your changes to take effect—otherwise, Windows

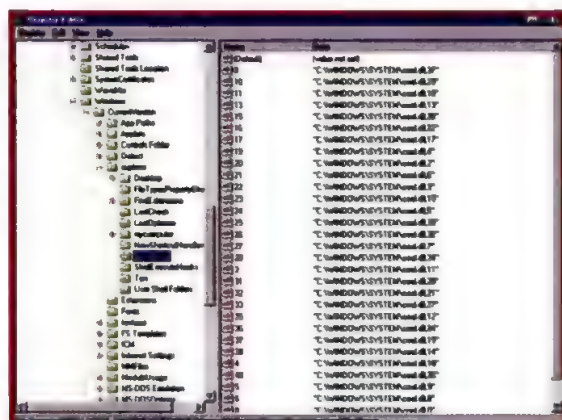


FIGURE 1: Icon values displayed in the Windows 95 Registry.

will continue to draw the old icons from `ShellIconCache`. As noted, one way to do this is to restart in DOS mode and delete the file `SHELLI-1`. This file is hidden, but the command `DEL TREE /Y SHELLI-1` issued in the Windows directory will wipe it out. You can also force Windows 95 to reread its shell icons by right-clicking the Desktop and changing the color depth (number of colors) in the Settings page of the Display Properties dialog. When the system restarts, it will reread all the icons in order to select the icon images most appropriate for the current display settings.

For more about Windows 95 icons, see this issue's Utilities column, "IconEdit: Customize Your Desktop."

WINDOWS 95 ICON VALUES

#	Type	Description	Default	With Microsoft Plus!	#	Type	Description	Default	With Microsoft Plus!
1	Explorer	Microsoft Network icon	Unknown	cool.dll,31	21	Start menu	Settings	shell32.dll,21	cool.dll,6
2	Explorer	Application	shell32.dll,2	shell32.dll,2	22	Start menu	Find	shell32.dll,22	cool.dll,3
3	Explorer	Closed folder	shell32.dll,3	cool.dll,11	23	Start menu	Help	shell32.dll,23	cool.dll,25
4	Explorer	Open folder	shell32.dll,4	cool.dll,18	24	Start menu	Run	shell32.dll,24	cool.dll,5
5	Explorer	5.25-inch disk drive icon	shell32.dll,5	cool.dll,9	25	Start menu	Suspend	shell32.dll,25	cool.dll,33
6	Explorer	3.5-inch disk drive icon	shell32.dll,6	cool.dll,8	26	Explorer	Eject PC (undock)	shell32.dll,26	cool.dll,32
7	Explorer	Removable drive	shell32.dll,7	shell32.dll,7	27	Start menu	Shut Down	shell32.dll,27	cool.dll,7
8	Explorer	Hard disk icon	shell32.dll,8	cool.dll,0	28	Explorer	Shared-folder tag	shell32.dll,28	cool.dll,34
9	Explorer	Network drive	shell32.dll,9	cool.dll,1	29	Miscellaneous	Shortcut arrow	Shell32.dll,29	Shell32.dll,29
10	Explorer	Off-line network drive	shell32.dll,10	cool.dll,29	30	Miscellaneous	Unknown	Unknown	Unknown
11	Explorer	CD-ROM drive	shell32.dll,11	cool.dll,10	31	Desktop	Empty Recycle Bin	shell32.dll,31	cool.dll,20
12	Explorer	RAM drive	shell32.dll,12	shell32.dll,12	32	Desktop	Full Recycle Bin	shell32.dll,32	cool.dll,21
13	Desktop	Entire Network icon	shell32.dll,13	cool.dll,13	33	Explorer	Dial-Up Networking folder	shell32.dll,33	cool.dll,27
14	Miscellaneous	Unknown	Unknown	Unknown	34	Explorer	Desktop folder	shell32.dll,34	shell32.dll,34
15	Desktop	My Computer	shell32.dll,15	cool.dll,16	35	Control Panel	Control Panel icon	shell32.dll,35	cool.dll,20
16	Control Panel	Printer icon	shell32.dll,16	cool.dll,22	36	Start menu	Program Group folder	shell32.dll,36	cool.dll,4
17	Desktop	Network Neighborhood	shell32.dll,17	cool.dll,18	37	Control Panel	Printers folder	shell32.dll,37	cool.dll,19
18	Desktop	Network Workgroup	shell32.dll,18	cool.dll,17	38	Start menu	Fonts folder icon	shell32.dll,38	cool.dll,14
19	Start menu	Programs	shell32.dll,19	cool.dll,4	39	Start menu	Taskbar icon	shell32.dll,39	shell32.dll,39
20	Start menu	Documents	shell32.dll,20	cool.dll,2	40	Explorer	Music CD icon	shell32.dll,40	cool.dll,26

FIGURE 2: This shows the default Registry values of icons as well as those when Microsoft Plus! is installed.



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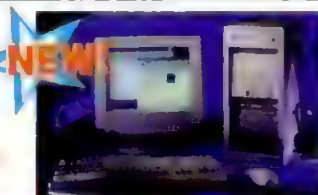
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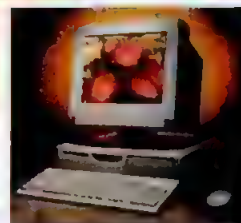
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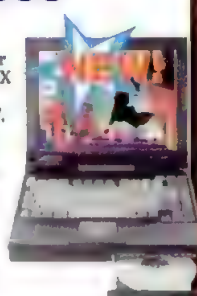
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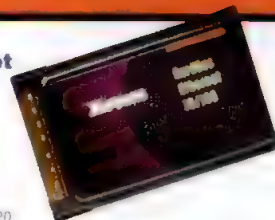


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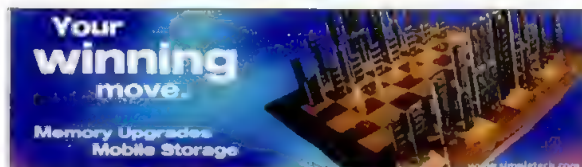
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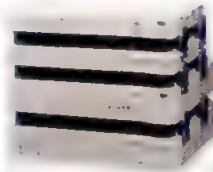
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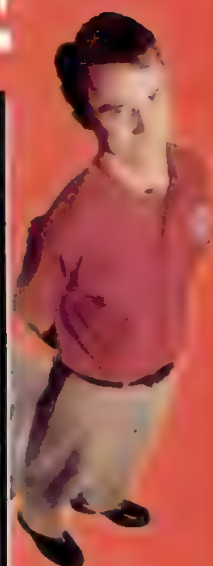


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Ask Our Advisors

HARDWARE

Bungled Boot

I've been using my SCSI-2 hard disk for six months with no problems. Then I bought a new 1.6GB IDE hard disk. Now my computer boots from the IDE drive and not the SCSI drive. Is there any way I can get the SCSI drive to be the boot drive?

DANIEL VAN DOVEREN
Brussels, Belgium

PC MAGAZINE: The way DOS and Windows 95 assign drive letters determines the sequence in which the drives are checked for booting. Unfortunately, there is no easy way to do what you ask.

Unless directed otherwise by the computer's CMOS settings, the boot process will start by looking to the first floppy disk drive, then to the hard disk C:. (Some BIOS programs let you choose between either an A: then C: drive sequence or a C: then A: sequence.)

The key, then, is how the computer decides which is the C: drive. DOS assigns the first drive letter to the first active primary DOS partition it finds. The first physical drive—or drive 1 as shown by the FDISK partition utility—must have an active primary DOS partition, so this will be the first one found. (Subsequent drives can be configured without a primary partition, if you choose.) This partition is assigned the C: drive letter.

The problem here is that IDE drives are “seen” by the computer before SCSI drives are, so adding an IDE drive will bump the SCSI-drive letter assignment down a notch in the alphabet.

The only way to continue to boot from the SCSI drive would be awkward at best: Create a boot floppy that transfers control to the D: drive (the SCSI drive) for the remainder of the boot process. This solution does not solve the bigger problem, which is the fact that the files on the SCSI drive will all be configured to look to the C: drive, which is now the new IDE drive. The best bet is to bite the bullet and transfer the contents of the SCSI drive to the IDE drive and let the computer boot from the new disk.—*Alfred Poor*

Through a Screen, Dimly

My LCD screen is getting dirty, so I'm hoping you know of a good way to clean one. I've been told that all cleaning materials used for CRT screens are harmful for LCD panels. I've

tried to wipe it with a dry cloth, but that doesn't clean the LCD thoroughly.

YUVAL SHALHEVET
via the Internet

PC MAGAZINE: You're right to be careful about how you clean an LCD panel; you don't want to use the same procedures you'd use on a standard CRT monitor.

A monitor has a glass front, but the front layer on an LCD screen is made of plastic. This is a special film that polarizes the light from the display; it may also perform other functions, such as light diffusion.

Plastic is much softer than glass and needs special treatment. For example, use only a soft cloth to wipe the screen. Do not use a hard paper towel, which could scratch the screen's surface.

Also, never spray any liquid directly on the screen. Instead, apply some to the soft cloth and then wipe the screen. Do not use standard glass-cleaning solutions; these could damage the plastic. The best cleaning solvent to use is rubbing alcohol, as this is what LCD panels are washed with before leaving the factory.—*Alfred Poor*

OPERATING ENVIRONMENTS

The Windows NT Command Processor Is Not DOS

In Windows NT 4.0, try the command:

```
echo 0>foo.txt
```

You receive the message “ECHO is on.” The 0 is ignored!

ECHO seems to have a bug—it will not echo a single digit correctly. But if you add a space, the command works. I use ECHO to create answers for DOS programs and then to direct each answer to the appropriate program. For example,

```
@echo off
echo Y>answers
echo 1>>answers
echo Q>>answers
myprogram < answers
```

In Windows NT 4.0, the answer can't be a single digit; Windows NT's DOS is screwy. What gives?

FRANK MEZZAT
via the Internet

PC MAGAZINE: This odd behavior is also present in Windows NT 3.51. Any attempt to echo a single digit and redirect the output to a file will fail. In Windows NT 3.51, echoing the digit 1 yields a file containing “ECHO is on,” and echoing any other digit yields a 0-byte file, with the “ECHO is on” message displayed on the screen. Windows NT 4.0 behaves in the same way, but echoing any of the digits 3 through 9 displays the message, “The handle could not be opened during redirection of handle #.” But this is not a bug, and it's not specific to the ECHO command!

The Windows NT command processor interprets a single digit followed by a redirection symbols as a request to redirect the handle represented by that single digit. Handles 0, 1, and 2 are the standard input, standard output, and standard error, respectively; the other seven don't have default definitions. To prevent Windows NT from interpreting the single digit as a handle number, you must precede the digit with a caret (^):

```
echo ^0>foo.txt
```

The important point here is that the Win-

OUR ADVISORS

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dows NT command processor is not DOS, despite its appearance. It's tempting to regard it as just another DOS version and to expect familiar DOS behavior, but doing so can get you into trouble. On the other hand, the Windows NT command processor—especially the 4.0 version—has many features not present in DOS. For example, the feature of redirecting standard handles is not restricted to the ECHO command, and it can actually be useful. Enter the following line in a Windows NT command prompt window:

```
dir filename 1>result.txt 2>error.txt
```

The file Result.txt will contain the DIR command's output, while the file Error.txt will contain any error messages. Try doing that in DOS!—Neil J. Rubenking

ONLINE

Make Netscape Navigator for OS/2 Dial Automatically

I really like using Netscape Navigator for OS/2, once it's connected. But it doesn't automatically dial my ISP like the Web Explorer browser bundled with OS/2; I have to make the connection manually before starting Navigator. Is there any way to make it do this automatically?

HELEN MCMAHON
New York, New York

PC MAGAZINE: You make dialing with Netscape Navigator automatic using the same technique Web Explorer uses. If you check the Web Explorer object's properties, you'll see that it loads not the browser itself but a program called Linkup.exe, passing the browser's filename as a parameter.

Linkup checks to see whether a TCP/IP connection already exists. If so, it proceeds to load whatever program has been passed to it as a parameter. If a connection doesn't exist, Linkup starts the Internet dialer program and waits until it detects that a TCP/IP session has been established. Linkup then loads the program found in its parameter list.

To use Linkup with Navigator, right-click on the Netscape Navigator icon and click on Properties in the pop-up menu. That will open the object properties dialog shown in Figure 1. Copy the path to Navigator from the Program Path and Filename field, and place it in the Optional Parameters field. Then change the Program Path and filename to Linkup.exe, as shown.

Note that this will change the object's icon from the Navigator steering wheel to the telephone associated with the dialer. To change it



FIGURE 1: By changing Navigator's properties as shown, you can get the program to dial automatically.

back, switch to the Icon page in the Properties Notebook. From the Taskbar, select the drive containing Navigator from OS/2 System I Drives. Then right-click on the Netscape folder to open it in a separate window. Drag the Navigator icon from Netscape.exe in that window and drop it onto the Icon page in the Properties Notebook you opened earlier to assign Linkup.—Brian Proffit

WORD PROCESSING

WordPerfect for Windows Panes

In WordPerfect for Windows 6.1 and 7, the default function key definitions include F6 for Next Pane and Shift-F6 for Previous Pane. However, there doesn't seem to be any reference in the manual, help file, or pull-down menus to explain what a pane is, and I have not been able to find anything that the command actually does.

In other programs I know of, panes are multiple, editable views of the same document, as distinct from windows opened for different documents, but WordPerfect doesn't seem to offer this feature. I've also seen the term refer to other kinds of windows on a document, like the Annotation panes or Footnote panes in Word. But again, this doesn't seem to be what WordPerfect means by panes. Can you explain what a pane is in WordPerfect and how to take advantage of this feature?

BRIAN DARVELL
via the Internet

PC MAGAZINE: If panes are explained anywhere in the WordPerfect manuals or help files, the explanations are well hidden.

Searching for "pane" in Help turns up a reference to the F6 and Shift-F6 keys, but not an explanation of panes. Nor did the term show up in the index for any version I have of the manual.

Panes are so well hidden, in fact, that a call to WordPerfect technical support got an initial response that the F6 and Shift-F6 keys don't do anything—even after my contact asked the rest of the support staff if any of them knew what the commands were for. The top secret status of panes makes them well worth talking about here.

A little experimentation, and some discussion with technical support, yielded the answer. Panes in WordPerfect come in two varieties (or, more precisely, two varieties I've been

able to find; there may be more). They are either multiple areas within the same editing screen, or they are the editing window on the one hand, and feature bars—WordPerfect's special purpose toolbars—on the other.

The Equation Editor is a good example of the first kind of pane. If you choose Graphics | Equation, WordPerfect will open the Equation Editor. F6 or Shift-F6 will then cycle you through the editing pane where you enter the text of the equation, the command list (or equation palette), and the display pane. (Unhelpfully, Help refers to the first and last as the "editing window" and the "display Window," respectively.)

Examples of the second kind of pane include the Macro feature bar, the Footnote feature bar, the Comment feature bar, and so on. Choose Insert | Footnote | Create to bring up the Footnote feature bar, for example, and F6 will toggle between the footnote itself, where you can enter text, and the Feature Bar Help And Options button. Once the button is selected, hitting the Spacebar will open the Help And Options menu. Hitting Tab will take you to the next button on the feature bar. If you prefer using the keyboard to the mouse, you may find F6 and Shift-F6 helpful in at least some situations.—M. David Stone

SPREADSHEETS

Working with Elapsed Time Values in Excel

I am using a Microsoft Excel spreadsheet to keep track of cycling events such as time and distance. I'm frustrated because, although I can enter and display the time in an hh:mm:ss

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format, I cannot use Excel to combine times into totals or divide a total time by a distance value to get average speed. Any ideas on how to do this?

ERIC WESLEY
via the Internet

PC MAGAZINE: Actually, you can do both of these things in Excel. To generate a time total, enter your input values by typing them in this format:

hh:mm:ss

Then simply add them up using a =SUM formula. Your total cell should also appear as an hh:mm:ss value, but if it does not for some reason, pull down the Format menu, choose Cells, click the Number tab, select the Time category, and choose the format that appears in the table below, next to your Excel version number:

Excel 5	[h]:mm:ss
Excel 7 (Excel 95)	26:30:55
Excel 97	37:30:55

(All three of these formats do the same thing; Microsoft just played with their identifiers when introducing new versions of Excel.)

In Excel 7 and Excel 97, be careful not to choose the format in which the first two digits are less than 24. Such a format will give you problems if your total elapsed time is greater than 24 hours, because Excel will subtract the highest multiple of 24 that's less than the total number of hours and display only the remainder.

When you're dividing a non-time value by a time value—for example, to divide distance by time—be aware that Excel records all time values internally as fractions of a day. For example, 12 hours is always stored as .5, 30 hours as 1.25, and so on. When you divide distance by time, you get distance per day, not distance per hour, minute, or second, regardless of how the time value may be displayed on your worksheet. Unfortunately, Excel likes to assign the result of such calculations the “37:30:55” format, even though that format is totally inappropriate for a distance-per-day result.

Thus, for example, if you put 30:00:00 into a cell, then divide that cell into, say, 1,500, Excel may display 28,800:00:00! That looks pretty useless, but if you change the format back to General, you get 1,200, the miles-per-day representation of 1,500 miles in 30 hours. To get miles per hour, you can then divide that result by 24.

Here are some things that you should

note about entering time values:

- If the hour component of the time that you're entering is 0, you need to include the 0, followed by a colon. If you type something like 2:30, instead of 0:2:30, your cell will display 2:30, but Excel will take that to mean 2 hours and 30 minutes, not 2 minutes and 30 seconds.

- If you type a time such as 16:07:21 into a cell that has the General format (usually that means a cell to which you haven't explicitly assigned a format), your cell will display the time as you have typed it. But in the formula bar, you may see something like 4:07:21 PM. That's because Excel regards the input as a time of day, even if you mean it as an interval. You can ignore the formula bar appearance of your entry, but if you want to change the cell's value, you'll need to re-enter from scratch rather than editing in the cell or on the formula bar. (The formula bar displays your input in accordance with the time format you select in Control Panel's Regional Settings applet. If you choose a 24-hour format there, all time inputs up to 23:59:59 will appear the same on the formula bar and on the worksheet.)

- If the cell where you enter your time value already has a format assigned to it, Excel uses that format. That won't affect your calculations, but it may make the visual result disconcerting. Just go back to the Format menu and assign the “37:30:55” format (or its equivalent in versions prior to Excel 97).

- You can type mm or ss values larger than 60 if you want to. For example, if you want to record a time of 99 seconds, you can type 0:0:99. If you enter this into a General-format cell, however, Excel will not automatically assign the “37:30:55” format. Instead, you'll see your time displayed as a decimal fraction of 86,400 (the number of seconds in one day). Simply assign the “37:30:55” (or equivalent) format yourself, and Excel will display your 99 seconds as 0:01:39.

- What about fractions of a second? You can enter them as well, but when you do, Excel assigns your input value a different format, one that appears in the Format dialog box (for Excel 97) as “30:55.7.” Be aware that in this format, as in the one labeled “13:30:55,” Excel displays times as remainders after subtracting the highest multiple of 24 hours.

- You can't directly enter negative time values. And if you multiply a time value by a negative number, Excel displays a row of number signs, regardless of your column width. It does that because it wants to display the result in a time format and cannot do so. Simply switch to any non-time format and all will be well.—Craig Stinson

DATABASES

Protecting Access Code and Objects

I'm working on an Access 2.0 program for Windows, and would like to protect the code and the design of my objects. But I've been told that there is no way for me to do this, short of purchasing the Access Developer's Toolkit. Is this true?

KHALED A. HATHLOUL
Riyadh, Saudi Arabia

PC MAGAZINE: I don't know of any way to protect your Access 2.0 code and design without using the Microsoft Access 2.0 Developer's Toolkit (ADT) to distribute a secure, encrypted application. The same limitations exist in Microsoft Access for Windows 95. Access 97 has a feature you can use, however, so I suggest you consider upgrading.

With Access 97 you can save your database as a special-format .MDE file, a step that compiles and strips away any Visual Basic source code and prevents user modifications to forms, reports, and modules. Doing so yields other benefits as well, because the resulting file is smaller than the original database file, a fact that helps Access optimize memory usage and improves performance.

You have to remember to keep a copy of your original database (.MDB file) in a safe place, however, just in case you need to alter your VBA source code or make design changes to forms or reports. You'll also need the original .MDB file to convert to future Access releases.—Sal Ricciardi

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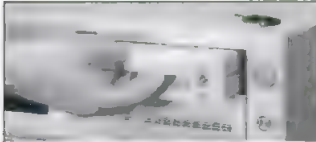
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1280MB	4500	Quantum	TM31280A	\$186
1281MB	5200	Western Digital	AC11200	\$181
1300MB	4200	JTS	JTS1300	\$169
1624MB	5200	Western Digital	AC21600	\$199
1670MB	4480	Maxtor	M81750A	\$195
1700MB	5400	Fujitsu	M16237	\$188
1700MB	4500	Seagate	ST31720A	\$190
2100MB	4103	JTS	JTS2000	\$188
2100MB	5400	Fujitsu	M16247	\$217
2100MB	5200	Western Digital	AC22100	\$209
2132MB	4500	Seagate	ST32132A	\$203
2151MB	5400	Quantum	FB32160A	\$221
2168MB	4500	Quantum	TM32160A	\$219
2187MB	4480	Maxtor	M82187A	\$218
2500MB	3600	Quantum	BF2500A	\$215
2500MB	5400	Fujitsu	M16367	\$215
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2560MB	5400	Maxtor	M82560A	\$219
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2150MB	7200	Seagate	ST52171N	\$548
2151MB	5400	Quantum	FB32160S	\$330
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3234MB	4500	Quantum	TM32300S	\$348
4100MB	7200	Micropolis	MC4341	\$699
4310MB	5400	Quantum	FB34320S	\$479
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4400MB	7200	Fujitsu	M2954S	\$729
4550MB	7200	Micropolis	MC4345S	\$729
4550MB	7200	Quantum	XP14550S	\$809
4550MB	10,000	Seagate	ST34501N	\$1049
4550MB	5400	Quantum	FB34501S	\$599
9100MB	7200	Micropolis	MC3391	\$1239
9100MB	7200	Fujitsu	M2949S	\$1269
9100MB	7200	Quantum	XP39100S	\$1329
9100MB	7200	Micropolis	MC3391AV	\$1339
9100MB	7200	Seagate	ST19101N	\$1689
9100MB	10,000	Seagate	ST19101N	\$3379
23300MB	5400	Seagate	ST423451N	\$3809

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WIDE	RPM	Brand	Model	Price
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2149MB	5411	Seagate	ST32155W	\$497
2150MB	7200	Seagate	ST32171W	\$599
4284MB	7200	Micropolis	MC3433W	\$729
4294MB	7200	Micropolis	MC3433WAV	\$789
4350MB	7200	Seagate	ST34371W	\$899
4400MB	7200	Fujitsu	M2954W	\$749
4550MB	7200	Micropolis	MC4345W	\$789
4550MB	7200	Micropolis	MC4345WAV	\$849
4550MB	7200	Quantum	XP14550W	\$839
4550MB	10,000	Seagate	ST34501W	\$1109
9091MB	5400	Micropolis	MC3391W	\$1399
9091MB	5400	Micropolis	MC3391WAV	\$1399
9100MB	7200	Fujitsu	M2949W	\$1309
9100MB	7200	Quantum	XP39100W	\$1359
9100MB	7200	Seagate	ST19101W	\$1789
9100MB	10,000	Seagate	ST19101W	\$3479
23300MB	5400	Seagate	ST423451W	\$3849

CD ROM DRIVES

IDE	Brand	Model	ms	Int
Speed				
8X	Mitsumi	CRMCFX800	150	\$91
12X	Mitsumi	CRMCFX12X	150	\$110
12X	Toshiba	XM5702B	115	\$104
16X	Lite On	LTN262A	120	\$105
16X	Mitsumi	CRMCFX16X	120	\$111
16X	Acer	AC706A	120	\$109
16X	NEC	CDR1600	100	\$125
16X	Toshiba	XM6002B	90	\$125
18X	Acer	AC616A	120	\$135

IDE CD CHANGERS

Speed	Brand	Model	# Disks	Int
6X	NEC	CDR4X6	4	\$99
8X	NEC	CDR4X8	4	\$139

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Speed	Brand	Model	ms	Int
12X	Toshiba	XM5701B	115	\$169
12X	Plexstor	PX12TS(tray)	105	\$219
12X	Plexstor	PX12CS(caddy)	105	\$269
15X	Toshiba	XM3801B	99	\$219
16X	NEC	CDR1610	100	\$199
20X	Plexstor	PX20TSE	95	\$239

SCSI CD CHANGERS

CD RECORDERS				
Speed	Brand	Model	# Disks	
8X	Nakamichi	MJ48S	4	\$229
4X	Pioneer	DRM624X	6	\$399

SCSI CD TOWERS

Speed	Brand	Model	4 Drive	7 Drive
12X	Toshiba	115ms	\$1029	\$1799
12X	Plexstor	105ms	\$1329	\$2299
15X	Toshiba	99ms	\$1399	\$2429
16X	NEC	100ms	\$1199	\$1999
20X	Plexstor	95ms	\$1499	\$2599

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Brand	Model	Price
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- Yamaha 4x6 Internal SCSI drive tray load (YCDR400T) \$639
- Internal SCSI drive caddy load (YCDR400T) \$649
- Philips 2x6 (\$200 Philips rebate until 6/30/97) Complete kit includes software, controller, and 1 disk. Internal SCSI (CDD2600) \$670
- Hewlett Packard SureStor 6020I SureStor 6020I includes software, and 1 disk. Internal SCSI (C4343CDR) \$450
- Complete internal kit w/ controller (C4343CDR-1) \$499
- External for parallel printer port (C4345A) \$569
- Sony 2x8 Internal IDE (CDU928S) \$369
- Kit w/ 1 disk, and software compatible with Win 95 & Win NT 3.51 & up. Requires IDE controller. Internal IDE (CDD2600T) \$409
- Mitsumi 2x6 Internal IDE includes 3 disks, and software compatible with Win 95 & Win NT 3.51 & up. Requires IDE controller. Internal IDE (CRMC2600T) \$499

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7-14Cig	8mm, 60MB, min	EXB8700LT	\$735
7-14Cig	8mm, 60MB, min	EXB8700	\$1069
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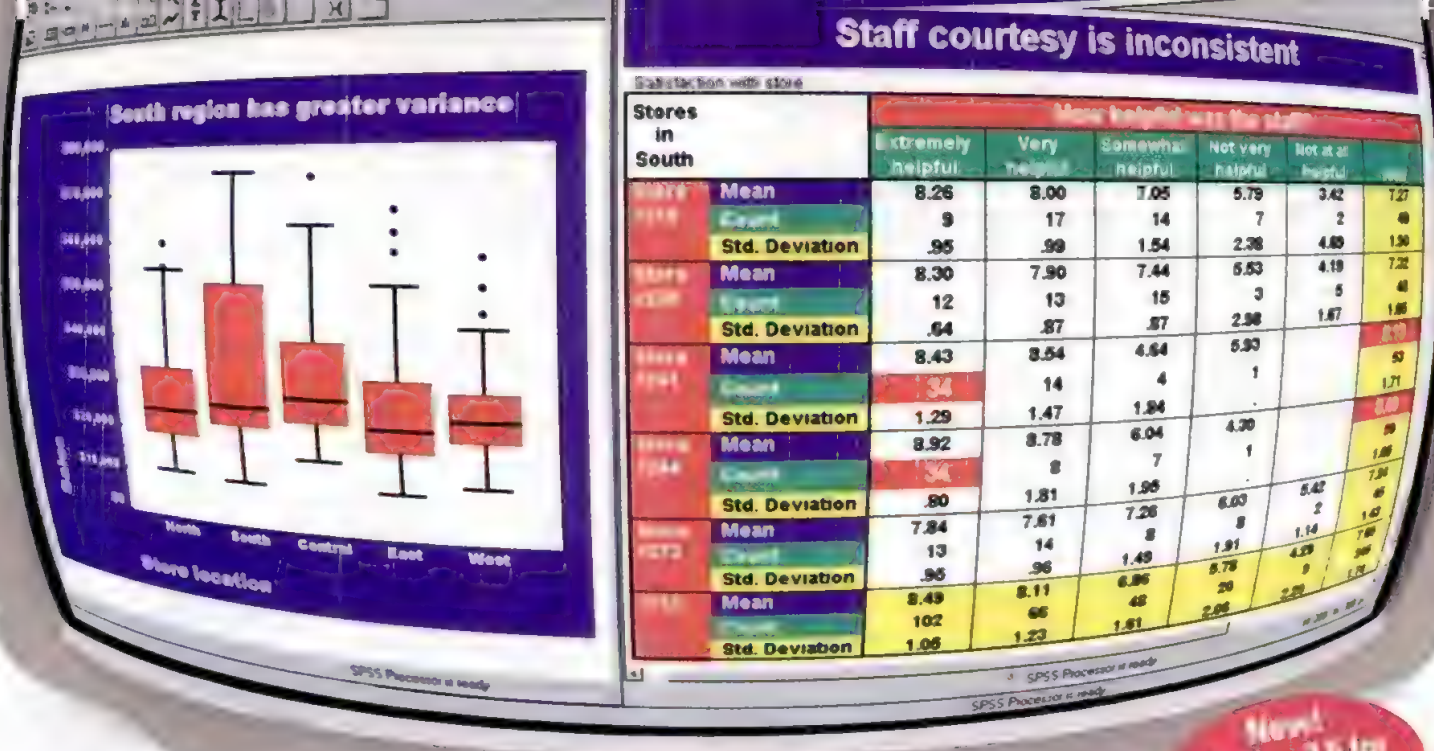
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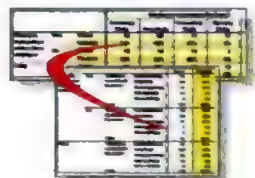
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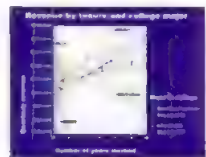
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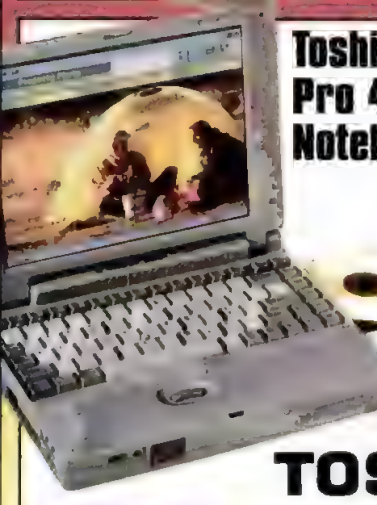
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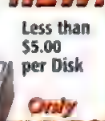
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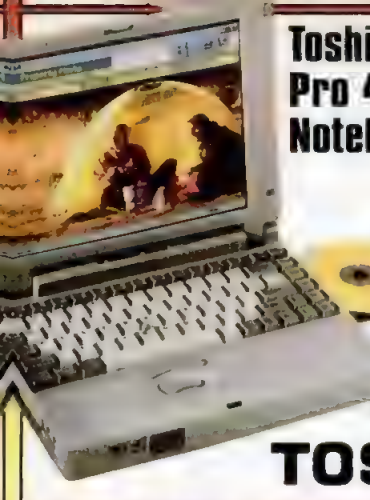
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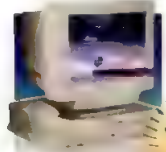
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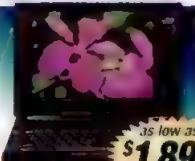


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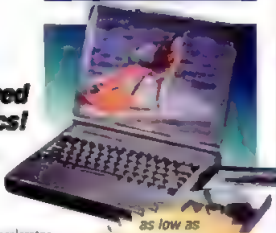
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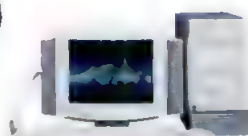
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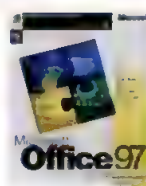
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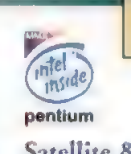
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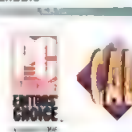


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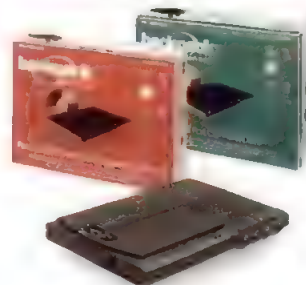


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8000CS P100 16MB 810MB 10.4" DS *2399	700LE P150 12.1" ACT 1.2GB *4349	
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IBM ThinkPad	OLIVETTI Echos	HITACHI Mx & E Series
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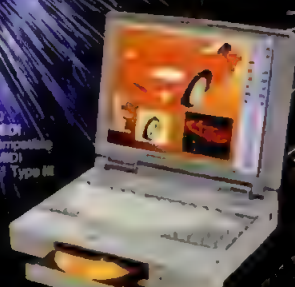
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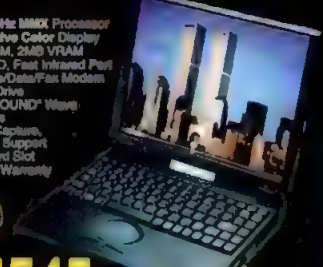
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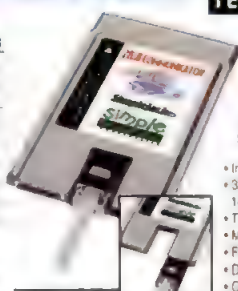
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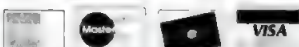
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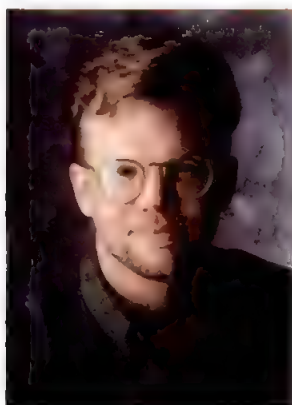
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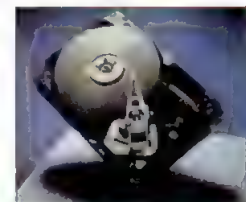


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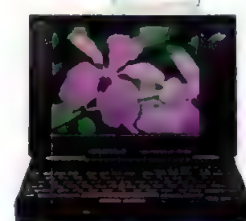


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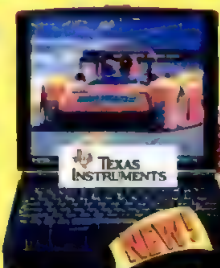
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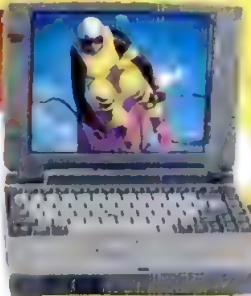
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Model	CPU	RAM	CD-ROM	Price
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C9E	200MHz MMX	32MB/3.2GB	16X	2099
S8C	166MHz MMX	32MB/3.2GB	16X	1999
S9C	200MHz MMX	32MB/4.2GB	16X	2599

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Model	Size	Resolution	Price
MM50	15"	1024 x 768	\$499
MM70	17"	1024 x 768	799

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2100	133MHz	24MB/2.0GB	8X	\$999
4764	166MHz MMX	24MB/2.5GB	16X	1799
4770	200MHz MMX	32MB/3.8GB	16X	2199

Presario Monitors

Model	Size	Resolution	Price
Presario	14"	1024 x 768	\$349
Presario	15"	1024 x 768	399
Presario	17"	1280 x 1024	749

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7130	133MHz	16MB/1.6GB	8X	1299
7160	166MHz	16MB/1.9GB	8X	1499
7161	166MHz MMX	32MB/2.1GB	12X	1999
7200	200MHz	16MB/3.0GB	8X	2099
7201	200MHz MMX	32MB/3.0GB	12X	2199

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Model	Size	Resolution	Price
Infinia	15"	1024 x 768	\$459
Infinia	17"	1280 x 1024	759

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Multimedia



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Model	CPU	RAM	CD-ROM	Price
7120	133MHz	16MB/1.6GB	6X	\$899*
7320	166MHz MMX	16MB/2.1GB	16X	1599
7360	200MHz MMX	32MB/3.8GB	16X	2299

Pavilion Monitors

Model	Size	Resolution	Price
Pavilion	15"	1024 x 768	\$449
Pavilion	17"	1024 x 768	749

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16X
CD-ROM

intel inside
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Model	CPU	RAM	CD-ROM	Price
9619	166MHz	16MB/2.0GB	6X	\$1199.97*
9710	166MHz MMX	16MB/2.1GB	8X	1799
9712	166MHz MMX	32MB/3.2GB	16X	1999

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† Factory Refurbished.			

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C115	P120 16MB 1.2GB 8X	842957	\$799*
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Monitor and system unit

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Toshiba			
7160	P166 16MB 1.9GB 8X	DT160U-06AB	\$999†
Packard Bell			
D141	P133 24MB 1.7GB 6X	845007	\$999
Compaq			
2100	P133 24MB 2.0GB 8X	285700-004	\$999
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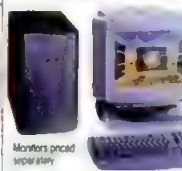


PRODUCT	PART	PRICE
7160 166MHz 16MB-1 9GB 8X	DT7160U-06AB	\$999.00
Infinia 15" 13.78" 1280 x 1024	DA 1766M-01	459.00
Infinia 17" 16.23" 1280 x 1024	DA 1766M-01	759.00

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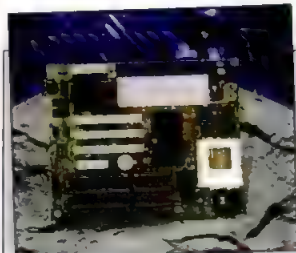
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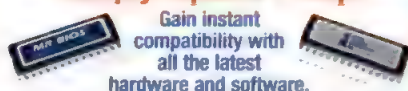
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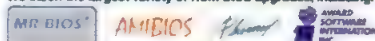
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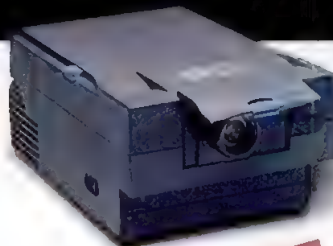
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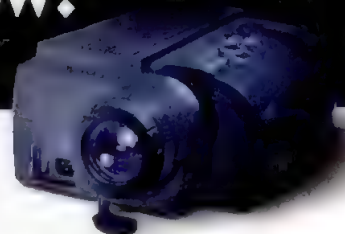
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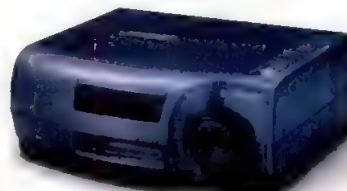
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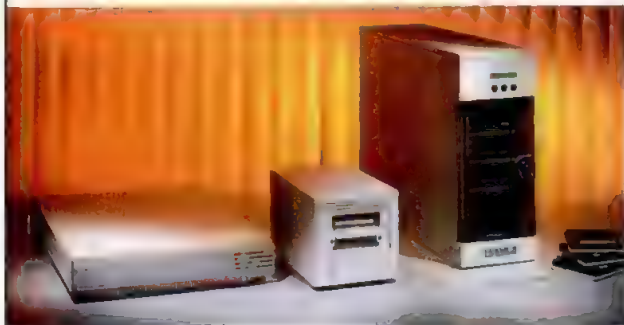
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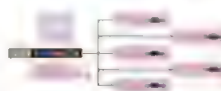


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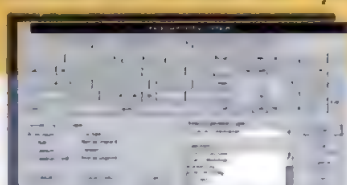
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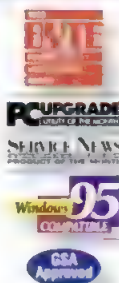


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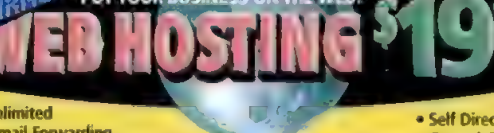
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1 x 6.6MB 72pin	\$22.00	4 x 6.6MB 72pin	\$80.00
1 x 13.2MB 72pin	\$24.00	4 x 13.2MB 72pin	\$85.00
1 x 26.4MB 72pin	\$26.00	4 x 26.4MB 72pin	\$90.00
1 x 52.8MB 72pin	\$28.00	4 x 52.8MB 72pin	\$95.00
1 x 105.6MB 72pin	\$30.00	4 x 105.6MB 72pin	\$100.00
1 x 211.2MB 72pin	\$32.00	4 x 211.2MB 72pin	\$105.00
1 x 422.4MB 72pin	\$34.00	4 x 422.4MB 72pin	\$110.00

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1 x 3.3MB 168pin	\$22.00	4 x 3.3MB 168pin	\$80.00
1 x 6.6MB 168pin	\$24.00	4 x 6.6MB 168pin	\$85.00
1 x 13.2MB 168pin	\$26.00	4 x 13.2MB 168pin	\$90.00
1 x 26.4MB 168pin	\$28.00	4 x 26.4MB 168pin	\$95.00
1 x 52.8MB 168pin	\$30.00	4 x 52.8MB 168pin	\$100.00
1 x 105.6MB 168pin	\$32.00	4 x 105.6MB 168pin	\$105.00
1 x 211.2MB 168pin	\$34.00	4 x 211.2MB 168pin	\$110.00

Model	Price	Model	Price
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1 x 3.3MB 168pin	\$22.00	4 x 3.3MB 168pin	\$80.00
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1 x 13.2MB 168pin	\$26.00	4 x 13.2MB 168pin	\$90.00
1 x 26.4MB 168pin	\$28.00	4 x 26.4MB 168pin	\$95.00
1 x 52.8MB 168pin	\$30.00	4 x 52.8MB 168pin	\$100.00
1 x 105.6MB 168pin	\$32.00	4 x 105.6MB 168pin	\$105.00
1 x 211.2MB 168pin	\$34.00	4 x 211.2MB 168pin	\$110.00

Model	Price	Model	Price
1 x 1.44MB 168pin	\$20.00	4 x 1.44MB 168pin	\$75.00
1 x 3.3MB 168pin	\$22.00	4 x 3.3MB 168pin	\$80.00
1 x 6.6MB 168pin	\$24.00	4 x 6.6MB 168pin	\$85.00
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1 x 26.4MB 168pin	\$28.00	4 x 26.4MB 168pin	\$95.00
1 x 52.8MB 168pin	\$30.00	4 x 52.8MB 168pin	\$100.00
1 x 105.6MB 168pin	\$32.00	4 x 105.6MB 168pin	\$105.00
1 x 211.2MB 168pin	\$34.00	4 x 211.2MB 168pin	\$110.00

Model	Price	Model	Price
1 x 1.44MB 168pin	\$20.00	4 x 1.44MB 168pin	\$75.00
1 x 3.3MB 168pin	\$22.00	4 x 3.3MB 168pin	\$80.00
1 x 6.6MB 168pin	\$24.00	4 x 6.6MB 168pin	\$85.00
1 x 13.2MB 168pin	\$26.00	4 x 13.2MB 168pin	\$90.00
1 x 26.4MB 168pin	\$28.00	4 x 26.4MB 168pin	\$95.00
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1 x 13.2MB 72pin	\$24.00	4 x 13.2MB 72pin	\$85.00
1 x 26.4MB 72pin	\$26.00	4 x 26.4MB 72pin	\$90.00
1 x 52.8MB 72pin	\$28.00	4 x 52.8MB 72pin	\$95.00
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1 x 211.2MB 72pin	\$32.00	4 x 211.2MB 72pin	\$105.00

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1 x 6.6MB 72pin	\$22.00	4 x 6.6MB 72pin	\$80.00
1 x 13.2MB 72pin	\$24.00	4 x 13.2MB 72pin	\$85.00
1 x 26.4MB 72pin	\$26.00	4 x 26.4MB 72pin	\$90.00
1 x 52.8MB 72pin	\$28.00	4 x 52.8MB 72pin	\$95.00
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1 x 6.6MB 72pin	\$22.00	4 x 6.6MB 72pin	\$80.00
1 x 13.2MB 72pin	\$24.00	4 x 13.2MB 72pin	\$85.00
1 x 26.4MB 72pin	\$26.00	4 x 26.4MB 72pin	\$90.00
1 x 52.8MB 72pin	\$28.00	4 x 52.8MB 72pin	\$95.00
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1 x 6.6MB 72pin	\$22.00	4 x 6.6MB 72pin	\$80.00
1 x 13.2MB 72pin	\$24.00	4 x 13.2MB 72pin	\$85.00
1 x 26.4MB 72pin	\$26.00	4 x 26.4MB 72pin	\$90.00
1 x 52.8MB 72pin	\$28.00	4 x 52.8MB 72pin	\$95.00
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1 x 211.2MB 72pin	\$32.00	4 x 211.2MB 72pin	\$105.00

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1 x 6.6MB 72pin	\$22.00	4 x 6.6MB 72pin	\$80.00
1 x 13.2MB 72pin	\$24.00	4 x 13.2MB 72pin	\$85.00
1 x 26.4MB 72pin	\$26.00	4 x 26.4MB 72pin	\$90.00
1 x 52.8MB 72pin	\$28.00	4 x 52.8MB 72pin	\$95.00
1 x 105.6MB 72pin	\$30.00	4 x 105.6MB 72pin	\$100.00
1 x 211.2MB 72pin	\$32.00	4 x 211.2MB 72pin	\$105.00

Model	Price	Model	Price
1 x 1.44MB 72pin	\$18.00	4 x 1.44MB 72pin	\$70.00
1 x 3.3MB 72pin	\$20.00	4 x 3.3MB 72pin	\$75.00
1 x 6.6MB 72pin	\$22.00	4 x 6.6MB 72pin	\$80.00
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1 x 52.8MB 72pin	\$28.00	4 x 52.8MB 72pin	\$95.00
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1 x 211.2MB 72pin	\$32.00	4 x 211.2MB 72pin	\$105.00

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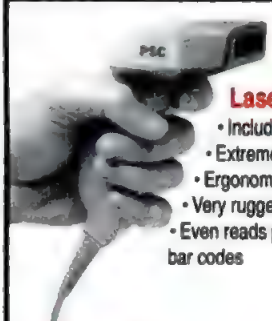
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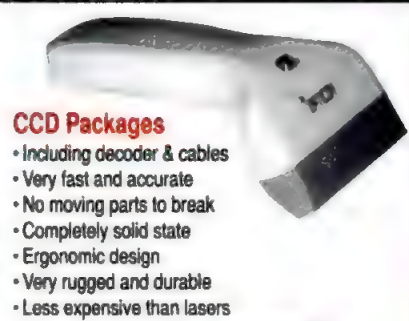
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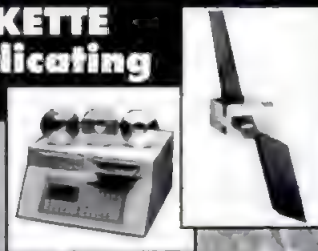
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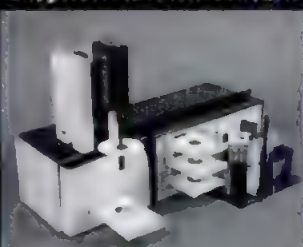
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After Hours

A Timeless Classic

Putt-Putt is better than ever in his latest adventure, one of the best kids' titles we've seen.

Putt-Putt Travels Through Time

The folks at Humongous Entertainment have done it again. Putt-Putt, that lovable little purple car, and his best pal, Pep, are back for their fourth animated children's adventure, *Putt-Putt Travels Through Time*. Even if you've

gest that you play with them, since you may have to help out on some of the game's more challenging puzzles.

As the adventure begins, Putt-Putt is on his way to school with his calculator, his lunch box, his prized history report, and Pep (who's just along for the ride). But a quick



of dinosaurs, the Middle Ages, the Old West, and the future. In each time period, you'll meet a variety of colorful characters. King Chariot, Virgil Clyde (a homebody horse), Darien the Librarian, and Wheel are just a few of the friendly faces you'll encounter.

These new friends will come in handy, since they can help you find Pep and your stuff by solving a few puzzles. One or two of these puzzles, such as tracking Pep in the desert, were a bit confusing at first, but the rest are very well explained and just challenging enough to be fun and addictive.

Along with these puzzles, you get a chance to play a few mini-games. Follow the Volcanoes, a pat-

tern game; Battery Maker, a basic math game; and Custom Pet Food Maker, a matching game were some of our favorites. We also liked the Silly Stories game, which lets you change the words and pictures in a series of suitably silly stories.

These mini-games alone are almost worth the price of admission. When you finish an adventure, you'll want to keep coming back just for them.

Another thing to keep you coming back: Each time you start a new game, the adventure is slightly different.

As you guide Putt-Putt through an adventure, you'll be treated to some of the best animation you can see on a PC. This game has a look and feel that is uniquely Humongous—highly impressive and of broadcast-quality throughout.

Also, the game is spilling over with clickable hot spots, most of which produce multiple animations just for fun (look for cameos by Fatty Bear, Freddi Fish, Pajama Sam, and other Humongous characters).

If *Putt-Putt Travels Through Time* has a downside, it's that the game may make you forget about all the other children's software you own.—Michael E. Ryan

INSIDE

EARLY LEARNING

Four educational CD-ROMs for your preschool-age kids. Page 362.



TIGGERIFIC READING

Disney's latest has Winnie the Pooh teaching basic reading skills. Page 370.

SICK AND TWISTED

Think you can manage this bizarre hospital? Page 370.



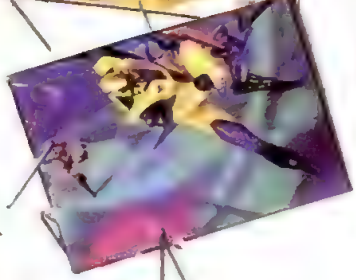
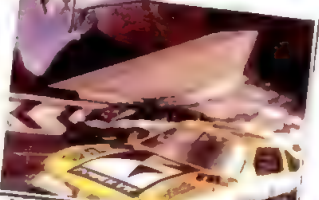
never seen any of the other Humongous titles, you owe it to yourself—and your kids—to take a look at this one.

Putt-Putt Travels Through Time runs on Windows 3.1 and Windows 95 PCs as well as on Apple Macintosh computers. The minimum requirements call for a mere 486/33 with 8MB RAM. The game is designed for kids aged 3 to 8, but if you have kids in the younger portion of that range, we sug-

gest that you play with them, since you may have to help out on some of the game's more challenging puzzles. As the adventure begins, Putt-Putt is on his way to school with his calculator, his lunch box, his prized history report, and Pep (who's just along for the ride). But a quick visit to Dr. Firebird's Lab ends in disaster. The good doctor's time machine is out of whack, and it scatters all of Putt-Putt's school supplies throughout the centuries. Worse, Pep valiantly jumps into the time machine to save the history report, and now he's lost in time as well. It's up to you to help Putt-Putt find his faithful friend and all his supplies.

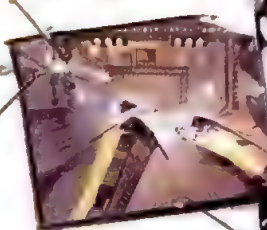
In order to do so, you must guide Putt-Putt through the age

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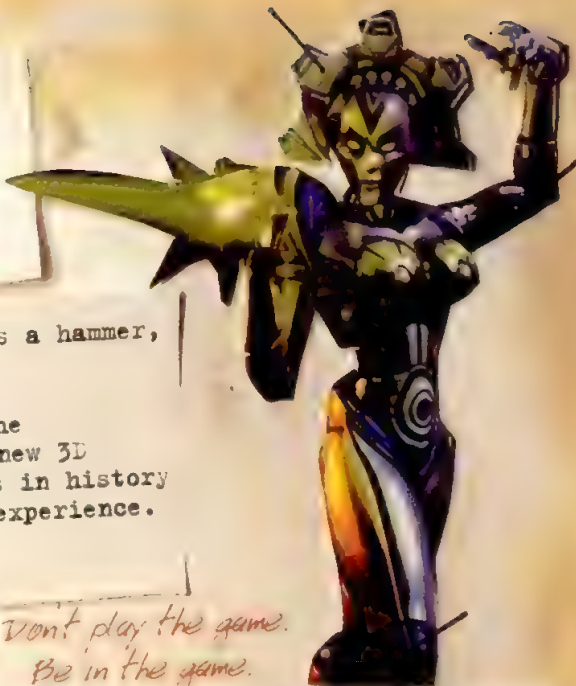
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Through a combination of solid, educational content, fun and funny characters to help present it, and—of course—sing-alongs, educational software can help kids learn valuable basic skills and have fun while doing so.

The four titles we reviewed are designed for preschoolers (ages 2 through 5). Each runs on Windows 3.1 and Windows 95 PCs as well as on Apple Macintoshes.

While we felt that all four titles are impressive and would be good choices for helping preschoolers get started, The Learning Company's Let's Start Learning! stands out as our Editors' Choice.

Elmo's Preschool Deluxe

If you spent the holidays in search of a Tickle Me Elmo doll, chances are that Elmo's Preschool Deluxe is on your kids' wish list as well. And with good reason, since this game does a wonderful job of bringing *Sesame Street's* time-honored teaching methods and sense of social awareness to a new medium.



The title includes two CDs: The first is all Elmo, all the time. Kids can explore Elmo's playground and play games that teach basic concepts such as counting or pattern and shape recognition. In each playground area, kids can play games in easy, more challenging, or free-play modes.

The second holds Search and Learn Adventures, starring Sherlock Hemlock and his dog, Watson, who enlist your child to help solve myster-

ies. Along the way, kids learn about social skills, hygiene, recycling, and other topics. Many of their beloved *Sesame Street* characters are involved, including Big Bird, Grover, and the Count.

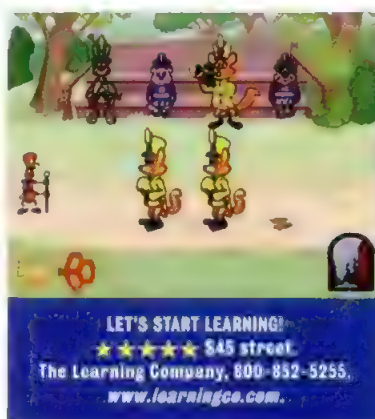
Unlike many kids' titles, Elmo's Preschool Deluxe does not offer a lot of clickable hot spots. The hot spots it does offer, however, produce some very funny and elaborate animations.

The game's solid content, wide range of activities, and lovable Muppet characters make it a good choice for any preschooler.—*Mary E. Behr and Michael E. Ryan*

JumpStart Preschool Deluxe

A longtime favorite, JumpStart Preschool Deluxe is a comprehensive package for beginning your child's education in a fun, friendly way.

On the first of two CDs, Casey Cat shows



your child around a tiny classroom full of clickable objects. Seven of these lead to activities, while most of the others play songs.

Each activity in JumpStart Preschool has three difficulty levels, which can be changed on the fly. Skills taught in the game include ABCs, letter sounds, colors, shapes, and sorting by shape.

For some reason, this portion of the program provides no feedback for wrong answers—it just won't let the child do the task in question. Each of the other titles reviewed here offers some form of helpful feedback.

The second CD lets kids play in a little town. By completing activities at the other locations in town, kids get to select a new animated object or character to place in the town's park.

The activities here emphasize problem solving and decision making, with some lessons on good manners and safety. Unlike the first CD, this one tells children if they pick an incorrect answer.

While we don't feel that JumpStart Preschool is the best product in this group, it remains a solid, reliable learning tool for young kids.

—*MEB and MER*

Let's Start Learning!



Though one of the oldest products in the group, Let's Start Learning! offers the best, most enjoyable learning experience for preschoolers.

The single CD is set up like a contest. Your child's goal is to complete four levels at four locations to unlock a carousel horse, who promises to take the child to the gates of the Learning Kingdom.

The four locations consist of the Counting Club, ABC Diner, Shape Shack, and Pattern Parade. As you might have guessed, the activities stressed include learning letters and numbers, pattern recognition, and sorting skills.

There are four skill levels in the game: discover, build, apply, and play. For example, in Pattern Parade, level 1 asks your child to make a parade based on one attribute (such as the color of the band members), while level 4



lets children make a parade based on whatever attribute they want.

The ABC Diner is another good activity. While Reader Rabbit and Ed the Dog are trying to teach letter recognition and sounds, a creature under the counter is busy eating all the incorrect answers.

Our only dislike: To access

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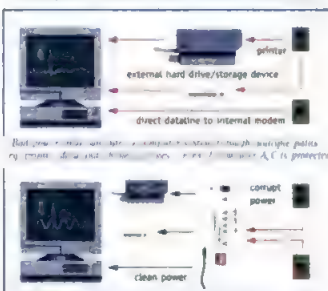
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After Hours

the game command screen, which offers level changes, a printable progress report, and adjustable sound and movement controls, you need to press Ctrl-P. A nice, big button on-screen would work much better.

Even so, *Let's Start Learning!* is a very impressive title. —MEB and MER

Fisher-Price Ready for Preschool

A bright and highly musical title, Fisher-Price Ready for Preschool teaches a combination of educational and common-sense skills. It comes on two CDs. The first lets kids play in a circus full of funny animals. By clicking on one of the animals, kids can jump to a different activity.

There are ten activities in all, and each activity offers a different kind of reward. After completing activities with Kar-

lee Kangaroo, for example, kids can pick a song on a tape and play it back on a virtual tape recorder.

This title offers the best wrong-answer feedback in our review group. When kids answer incorrectly, the program urges them to try again and offers increasingly easy clues.

The second CD, a parents' disk, is unique in this product group. It has a section of video segments in which Jan Davidson, the company's founder, offers advice on preparing your child for preschool. This disk also lets you print 50 activity pages and includes three activity books.

Fisher-Price Ready for Preschool is not quite as impressive overall as *Let's Start Learning!*, but it's still a solid learning tool that children and parents alike can enjoy.

—MEB and MER

QUICK CLIPS

MechWarrior Battle Pack



A big box filled with action, this collection contains MechWarrior 2, the Ghost Bear's Legacy expansion pack, and NetMech, each enhanced to support the impressive graphics engine of MechWarrior 2: Mercenaries. The package even includes a book on Mech strategy. \$49.99 list; Activision, 800-477-3650, www.activision.com.

Amazing Animals Activity Pack



Henry the Lizard is your guide through this fantastic adaptation of the TV show "Amazing Animals." Kids aged 5 to 9 can play through more than 20 learning activities, read through 2 colorful animal books, or build the included bird mobile. For less than \$30, this is quite a deal. \$29.95 list; DK Multimedia, 800-356-6575, www.dk.com.



Darklight Conflict



Ready for fast and furious space combat with stunning visuals and excellent multiplayer capabilities? This is no Wing Commander, but it is a lot of fun over a LAN, and the plot is fairly compelling—reminiscent of Star Crusader. \$50 street; Electronic Arts, 800-245-4525, www.ea.com.

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November 1996

"Ventura Publisher 7.0 opens up a new market for itself, not merely as a large-document publisher, but as a temptingly easy-to-use, multipurpose publishing application... all in one package. It's a tough act to follow."



PC Week

November 25, 1996

"Corel Ventura 7 for Windows 95 and Windows NT is a smart upgrade as well as a good first-time purchase. The page layout program's strong Web-page design capabilities are a bonus and the bundling of Corel WordPerfect 7, Corel Database Publisher and Corel Photo-Paint with Ventura 7 makes for a robust combination of desktop-publishing applications."



Windows Sources

October 1996

"Corel's Ventura 7 is rocketing to the top of the charts, thanks to a revamped interface and support for cutting-edge Web publishing."

"We were delighted with every facet of Ventura 7."



MacWeek, Seybold Show Daily

September 10, 1996

"... the new Corel-style interface offers more context-sensitive tool and palette selection than anything I've seen. Ventura is still strong on long documents, too, and the table-creation feature is hot."



★ ★ ★ ★

Publish

March 1997

"Version 7 is a major programming achievement and has returned Ventura to the pantheon of professional layout software..."

"Corel Ventura 7 is significantly better than its forebears at creating short, design-intensive documents such as brochures, ads, and promotional pieces."

"Corel Ventura is back on my play list."



InfoWorld

July 15, 1996

"... the new Corel Ventura 7 currently offers the most alternative publishing options, and they are better-designed than those that you'll find elsewhere. Ventura 7 now equals and often surpasses the functionality of its competitors."



PC World

September 1996

"You can publish Java, Common Ground, and Envoy (Acrobat-like) documents. Java format, for example, lets you use pop-up windows, multiple fonts, and more in your online documents. Ventura 7 also comes with WordPerfect SGML so you can work with SGML documents or import them into Ventura 7. QuickTime movies? No sweat, Ventura does those too."



Home Office Computing

August 1996

"Considering the strength of Corel Ventura's DTP functions and the wealth of extras in the package, this is an affordable and powerful way to produce your own publications."



The Seybold Report on Desktop Publishing

August 12, 1996

"It is for those buying their first page composition program that Ventura 7 has the most appeal. The product has all of today's checklist features and lots of extras thrown in free."

"... Ventura is on its way back, and it's aiming at nothing less than to be at the top of the heap."

The verdict is in. Corel VENTURA™ 7 has leapt ahead of Adobe® PageMaker® and QuarkXPress™ for power publishing.

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Reading the Pooh Way

Winnie the Pooh and friends star in this enjoyable educational title.

Disney's Learning to Read With Pooh

Come along with Pooh, Piglet, Tigger, and the rest for an educational trip through the 100-Acre Wood. Disney's Learning to Read with Pooh is a well-rounded and well-designed learning game that's a lot of fun to play.

Learning to Read with Pooh is designed for ages 3 to 6. It runs on Windows 3.1 and Windows 95 PCs, as well as on Apple Macintosh computers. The title's system requirements are more than reasonable: a 486/66 with 8MB RAM.

As the game begins, Pooh

will show you your very own tree house in the Wood. After completing each of the game's nine activities, you'll win a toy or another object to spruce up your tree.

The prizes range from boomerangs to a book of A. A. Milne poetry (our favorite). Any time you want to check out your prizes, you can head back to the tree and click on them. From time to time, you'll even find mail from Pooh or some of his friends

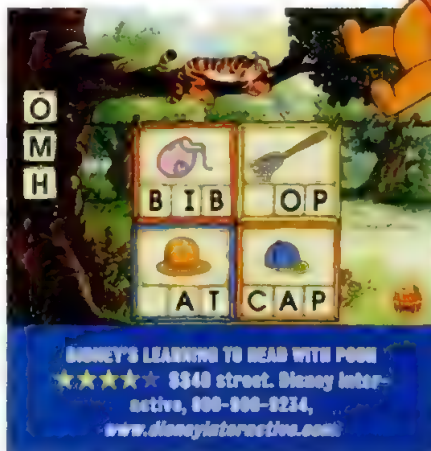
waiting for you there.

But first, you need to try some of the activities. Each has three difficulty levels, with a different tree house decoration awarded for each level. These activities cover a variety of topics, including the alphabet, letter drawing, rhyming, basic spelling, and listening

comprehension. We especially liked the rhyming segment, in which you get to fix Owl's poetry while Tigger provides the background music.

Along the way, Pooh and his friends pop up to explain the various activities. Occasionally a character will react on screen or tell you when you answer a question incorrectly. But most of the time, Learning to Read with Pooh offers very little feedback for wrong answers; we feel that the program would be even better without this inconsistency.

But the many songs, animations, and well-designed activities more than make up for this. Disney's Learning to Read with Pooh is a very good title that should help develop any young Pooh fan's reading skills.—MER



Playing Doctor

Bullfrog's humorous hospital sim is quite sick, but that's part of the fun.

Theme Hospital

You may not be a doctor in real life, but now you can act like one on your PC. Load up Theme Hospital and

you can start diagnosing and treating such exotic diseases as Bloaty Head Syndrome and Hairytitis. Then ream the hapless victims for all that their

checkbooks can handle.

Theme Hospital runs under DOS and Windows but has different system requirements for each. For DOS, you need a 486/66 with 8MB RAM and a 2X CD-ROM drive. For Windows 95, you need a Pentium/60 with 16MB RAM and a 4X CD-ROM drive.

Your mission is to design and build a hospital. You'll have to make sure you include all the proper facilities, staff them with competent (but willingly underpaid) personnel, and manage the place well to keep your cure-to-death ratio reasonably high.

Once your hospital is built, patients start pouring in. The first few are easy to handle: initial visit, diagnosis, cure. That'll be \$1,000, and thank you very much.

But as your reputation grows, the real problems arrive. People with Bloated Heads in desperate need of popping, patients with TV

Personalities seeking psychiatric help, and other problems will keep you quite busy. Also, epidemics may break out from time to time, and you have to decide whether to own up to them or cover them up and find a cure before word leaks to the press.

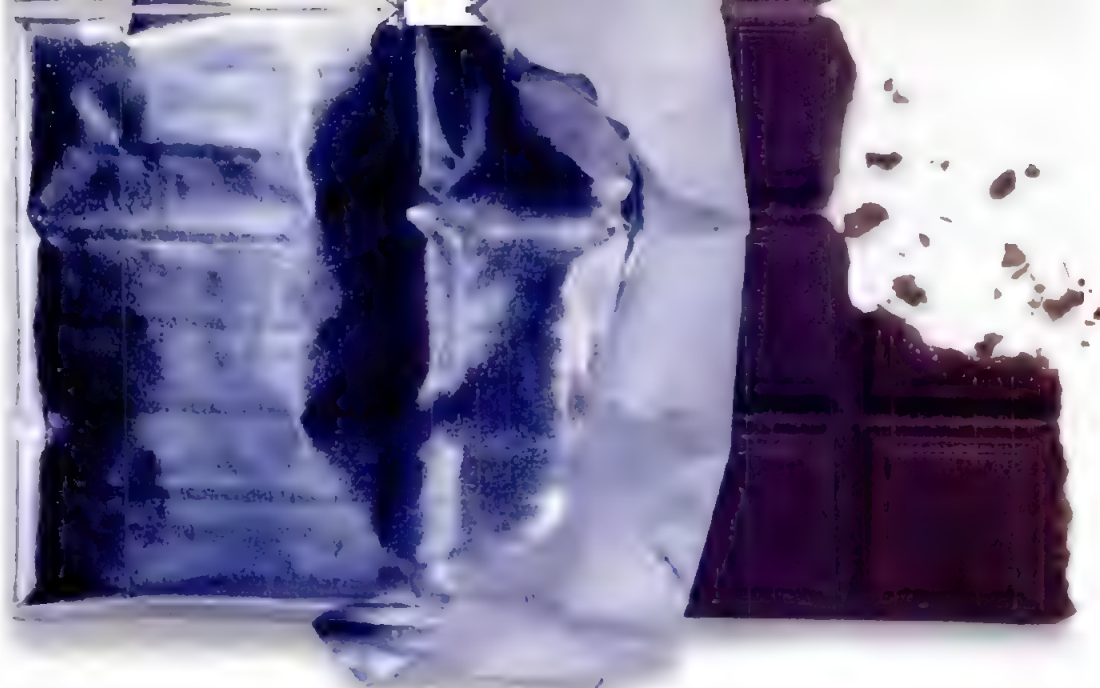
The game's graphics and animations are very good and quite funny. We watched patients get diagnosed, treated, and, occasionally, get physically sick on our floors.

Theme Hospital does have a few flaws. The game's tutorial was barely helpful, many of the "informative" icons were not clearly explained, and the game has no adjustable difficulty settings. But these are relatively minor quibbles, and none had a significant impact on game play.

If you ache for a new economic sim and don't take death and dismemberment too seriously, Theme Hospital is the cure for you.—Shane Mooney



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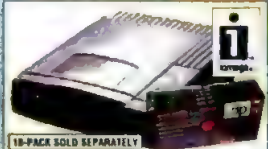
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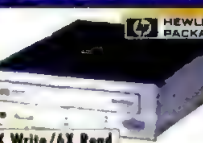
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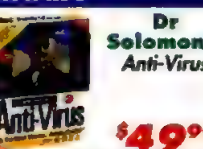
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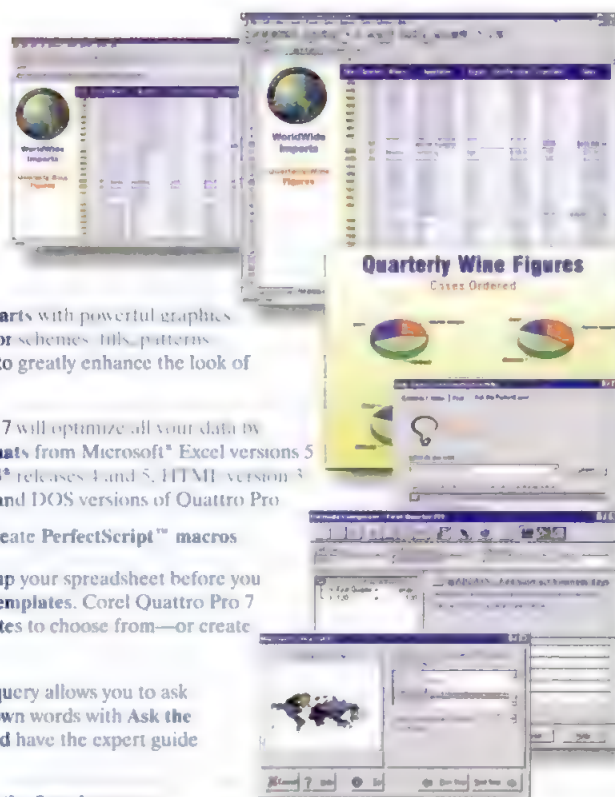
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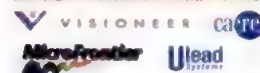
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The Perfect PC

It's here again—our annual look at what goes into the Perfect PC. We take you inside the PC so that you can choose a system with the right combination of components and peripherals. This includes the CPU, motherboard, RAM, buses, graphics and video, monitor, hard disk and interface, mass storage and removable media, CD-ROM, sound card and speakers, and connection choices. We do the same thing for the Perfect Portable PC—and also recommend the best connectivity hardware and wiring choices.

PC Service & Reliability, Software Support & Satisfaction

Our annual surveys ask our readers about their purchase decisions and experience with vendors over the past year.

The PC Magazine Top 100

We've added a new twist to our annual list of the top 100 computer companies: We give our take on which are the 100 most influential companies in our industry.



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Abort, Retry, Fail?

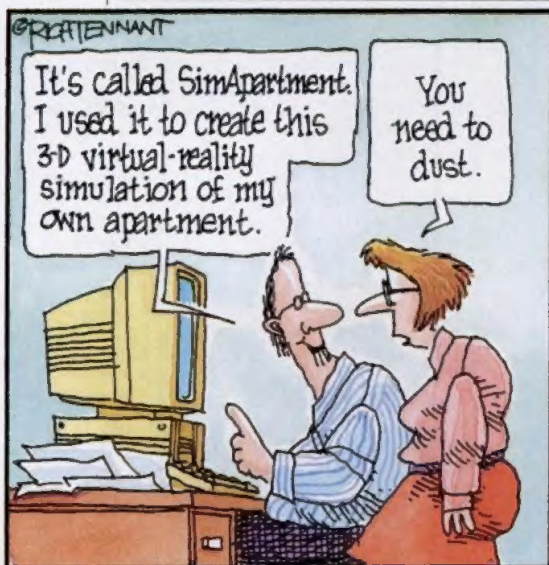
Year 200 could be cyber chaos

Experts are expecting a shortage of chisels and stone tablets. (*The Weekly Record*, Shrewsbury, MA.)



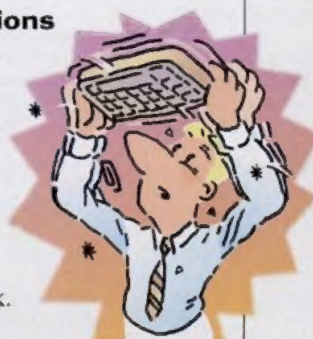
Press Releases We Never Finished Reading

"OnLive! Technologies, provider of the first commercial Internet software that enables large groups of people to talk over the Internet [www.online.com] today announced a partnership with the Klingon Language Institute, allowing Internet users the opportunity to discuss and practice the alien language with others."



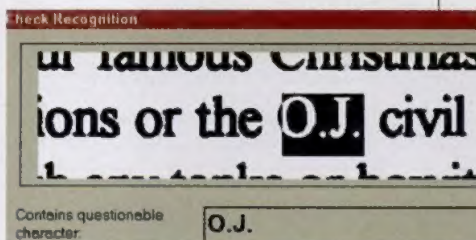
Daffy Definitions

Keyboard dandruff (n.) Turn your keyboard upside down, hold it over a desk, and shake it vigorously. Look at the desk. Look at what's on the desk. That is keyboard dandruff.



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Caere's OmniPage comes to its own conclusion about the Juice.

Yeah, but They'll Be a Real Drag To Lug Around

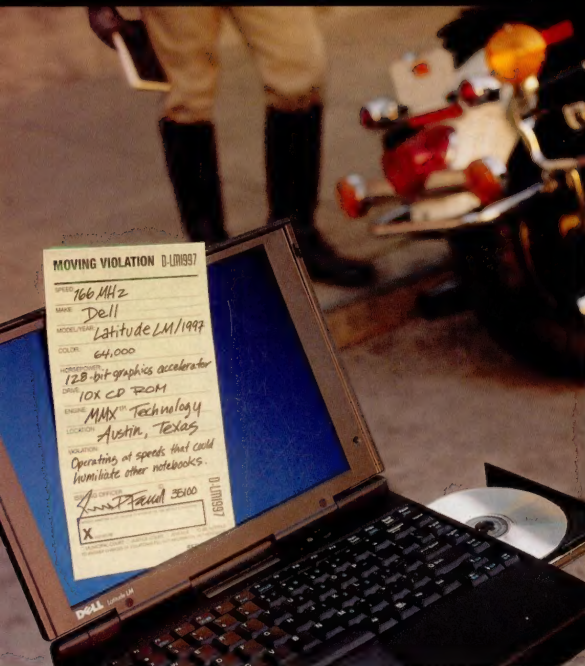


"Cellular phones with built-in mainframes might take over many tasks now handled by Intel-compatible PCs."—*BusinessWeek*

If your entry is used, we'll send you \$50 and a *PC Magazine* T-shirt. Send your entries to Abort, Retry, Fail?, *PC Magazine*, One Park Ave., New York, NY 10016-5802 or via e-mail to don_willmott@zd.com. Winners this issue: Robert Kaufman, Rob Kody, Thomas Oh, and Frank Sheffield.

ILLUSTRATIONS BY DAVID SPURLOCK

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